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JTIDS CLASS 3 TERMINAL CONCEPTUAL STUDY

FINAL REPORT

APPENDIX A Mission Profile Detail

APPENDIX B Moments of the Decision Variable for Preamble Detection (U)

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Prepared for:
ELECTRONIC SYSTEMS DIVISION AFSC, USAF
Hanscom Air Force Base, Mass. 01731

JTIDS

GTE SYLVANIA INCORPORATED
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Concepts for application and design of a JTIDS class 3 terminal were studied. Selected missions were analyzed to determine the requirements on bands of performance that should be met by the design. Useages include ground-to-ground and ground-to-air communications utilizing terminals modularly designed for manpack, vehicular, and airborne applications. The most stringent of the designs, the manpack terminal, was studied to determine feasibility design approach, cost, and ability to meet system requirements.

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It was concluded that moderate terminal throughput rates with good anti-jam protection is achievable with affordable terminals. The manpack terminal would meet size, weight, and power consumption requirements. The cost-effectivity of including Position Location and Navigation or Digital Message Device capability was also studied.

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APPENDIX A.

MISSION PROFILE DETAIL.

Appendix B.

Moments of the Decision Variable
for Preamble Detection.

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TABLE OF CONTENTS - APPENDIX A

In the first

(U) MISSION PROFILE DETAIL (U)

This appendix presents the entire mission profile analysis. It is published separate from the JTIDS Class 3 Study Final Report because the number of missions analyzed represents most scenarios applicable to surface combat and the detail is such as to make this compilation valuable as a reference source. It is based on current manuals, documentation and concepts; and as such it provides a most valuable baseline visualization of the current potential user environment for the command, control and communication system engineer.

The first section compiles eight general possible constraints to the Class 3 system imposed by fourteen different operation or mission profiles. These constraints are as follows: terrain use, threat proximity, mobility, voice/data, system interfaces, position location/navigation, JTIDS interoperability, and graphic display. The section ends with summary charts for each of the services. (Army, Navy, Air Force and Marine Corp). 1.2.B-1

The second section describes several approaches for organizing the potential users into networks according to system, mission or function. Eleven types of networks are established. Section three analyzes these networks to derive capacity, typical connectivity, range, message types, relay and possible partitioning for multiple net requirements. A comparison of the configurations and ranges as developed in the first section is made with the SCORES SCENARIO 3A.

The fourth section compiles a summary of terminal characteristics of the various Class 3 terminal configurations as developed during the mission profile and network analysis.

In order to keep this appendix unclassified for more general and convenient use, several of the classified mission profile sections are published as a supplement to this appendix.

1.0 MISSION CONSTRAINTS ON BANDS OF PERFORMANCE

The following paragraphs describe the mission constraints that may affect the bands of performance of the JTIDS Class 3 terminal. To facilitate analysis, these constraints are broken down into specific categories. The constraints and categories are defined to describe their applicability. A discussion of these constraints is presented along with supporting tables that specify the users operating in given mission operational concepts/profiles. The following constraints are presented:

- Terrain Use
- Threat Proximity
- Mobility
- Voice/Data
- System Interfaces
- Position Location/Navigation
- JTIDS Interoperability
- Graphic Display

1.1 DEFINITIONS

The following paragraphs present definitions of the mission constraints and subcategories to describe their applicability to the analysis.

1.1.1 Terrain Use. Here is presented how each element makes use of the terrain in limiting observation by the enemy and how such utilization may limit the selection of antenna sites. This constraint is broken down

into these categories based on terrain utilization, enemy observation capability, and antenna site selection.

1.1.1.1 Category 1 - in this category, the element is under the direct observation of the enemy, maximum use is made of cover and concealment, and the element is not free to select the antenna site but must locate the antenna in such a way as to minimize disclosure to the enemy.

1.1.1.2 Category 2 - in this category, the element is not under direct observation by the enemy, uses cover and concealment when it does not hinder operations, and has limited freedom to select an antenna site.

1.1.1.3 Category 3 - in this category, the element is located far enough from the front lines that enemy observation is negligible, cover and concealment is not of great importance except for overhead cover, location to provide maximum communications advantage is paramount, and there is complete freedom to select antenna site.

1.1.2 Threat Proximity. For each mission, a set of users exists who are spread to some degree across the battlefield. For each mission analyzed, a set of representative zones are presented which indicate the relative position of the users in relationship to the forward edge of the battle area (FEBA). Diagrams are used where possible to graphically depict the geographical relationships of the users. This analysis by zones will indicate the relative proximity to threat activities for the various elements. The zone designations specify approximate distances

from the FEBA measured in kilometers. The distances in these zones may fluctuate depending on the specific operational environment but those given are considered representative for use in this evaluation.

1.1.2.1 Zone F - the area forward of the FEBA in which enemy forces are employed and in which our combat outposts and general outposts may be located. It also is the area in which strike aircraft and assault forces operate and air heads, beach heads, and landing zones are located.

1.1.2.2 Zone A - 0 to 5 Kms behind the FEBA. Generally, the area in which company, platoon, and section size elements are employed.

1.1.2.3 Zone B - 5 to 10 Kms behind the FEBA. Generally, the area in which command posts, supporting units and reserves of battalion size units are employed.

1.1.2.4 Zone C - 10 to 20 Kms behind the FEBA. Generally, the area in which command posts, supporting units and reserves of brigade size units are located. The tactical CP of a division size unit may also be located in this zone.

1.1.2.5 Zone D - 20 to 55 Kms behind the FEBA. Generally, the area in which command posts, supporting units and reserves of a division size unit are located.

1.1.2.6 Zone E - 55 to 150 Kms behind the FEBA. Generally, the area in which command posts, supporting units, and reserves of a Corps size unit are located.

1.1.2.7 Graphically, we can depict the zones as follows:

Zone	Distance	Echelon
F	Forward of FEBA	Area of: STRIKE AIRCRAFT ASSAULT FORCES AIR HEADS BEACH HEADS LANDING ZONES etc.
FEBA		
A	0-5 Km behind FEBA	Co.
B	5-10 Km behind FEBA	Bn
C	10-20 Km behind FEBA	Bde
D	20-55 Km behind FEBA	Div
E	55-150 Km behind FEBA	Corps

1.1.3 Mobility. Some facilities tend to operate from relatively fixed positions on the battlefield, other facilities are constantly on the move, while still others fall somewhere in between with movement being made as the operational situation dictates. Nearly all elements described for study operate in or near vehicles for a significant part of their mission. Here we will identify the relative employment of vehicles and the type of vehicle that is employed. Also presented is the frequency of movement of the various elements based on the conduct of the mission and the extent of operations while on the move.

1.1.3.1 Vehicle Utilization - this factor is broken down into the following categories:

1.1.3.1.1 Category A - Always mounted with the type of vehicle employed. This category indicates that the element always operates from the specified vehicle type.

1.1.3.1.2 Category U - Usually mounted with the type of vehicle employed. This category indicates that the element usually operates from the specified vehicle type for a significant part of its mission but there may be times, based on the operational situation and mission, that the element may have to operate dismounted, away from the vehicle; i.e., in a man pack mode.

1.1.3.1.3 Category S - Seldom mounted. This category indicates that the element normally operates in a dismounted, away from the vehicle, man pack mode but does have the capability of movement when the mission dictates. The type vehicle employed for such movement is identified by type.

1.1.3.2 Frequency of Movement. This factor is presented as the number of hours or number of days between moves. The designation is by number representing number of hours or days and the letter H or D to indicate hours or days respectively (e.g. 4H would indicate 4 hours between moves; 2D would indicate 2 days between moves). Where the element is always on the move (e.g. aircraft), the letter A will be used to indicate constant movement.

1.1.3.3 Operations while on the Move. In this factor, determination is made as to the extent of operations while on the move. This factor is broken down into three categories based on the extent of execution that is conducted while on the move. The appropriate letter

of the particular category is inserted in the table.

1.1.3.3.1 Category A - in this category, complete mission execution is conducted while on the move. Communication transmission and reception is necessary and all actions for mission accomplishment are handled while moving.

1.1.3.3.2 Category B - in this category, the element is capable of transmitting and receiving data and recording but only can handle limited execution of mission actions. Must eventually stop movement in order to complete execution.

1.1.3.3.3 Category C - in this category, the element may be able to transmit and receive data but has no capability of executing mission actions while on the move.

1.1.4 Voice/Data. Here is presented the type of information flow (voice/data) from and to the specific user. A V indicates that all traffic is by voice; a D indicates that all traffic is by data. If the information passed is both voice and data, both letters V and D will be used.

1.1.5 System Interfaces. For each element analyzed, the type of digital equipment of a specific tactical data system available with the user will be indicated. This will serve to define the potential digital interfaces to be examined for the terminal. For example, if the user operates in the TACFIRE system, the appropriate digital device of the TACFIRE system will be indicated (i.e., DMD/TACFIRE; computer/TACFIRE).

1.1.6 Position Location/Navigation. The degree of accuracy to which each element must know its own location is a function of the operational mission and role of the element. This constraint is broken down into its two segments, position location and navigation.

1.1.6.1 Position Location. Indicated here is the degree of accuracy that is desired for the element. This entry is expressed in relationship to 30 meters. Desired accuracy above 30 meters is expressed as a "+", while an accuracy of 30 meters or less is expressed as a "-".

1.1.6.2 Navigation - indicated here is whether or not the element has navigational requirements. A letter Y designates a positive response while a letter N denotes a negative response.

1.1.7 JTIDS Interoperability. Here is indicated if the particular users terminal would require the capability to interface with Class 1 and/or Class 2 JTIDS terminals. A letter Y designates a positive response while a letter N denotes a negative response.

1.1.8 Graphic Display. Here is indicated whether or not a graphic display in the Class 3 terminal is desirable. A letter Y designates that the graphic display is desirable; a letter N denotes that it is not needed.

1.2 Analysis and Tabular Presentation. The following paragraphs discuss the applicability of the various constraints as they pertain to given mission profiles. A separate paragraph is presented for each separate mission operational concept/profile analyzed. Supporting mission constraint tables are provided which present the users that normally operate in a

given mission environment and indicates the specific mission constraints that are applicable for each user. Amplifying notes are included with the tables to provide supplemental information that cannot appear in the tables. The following mission operational concepts/profiles are discussed in paragraphs as indicated:

Operation/Mission Profile	Paragraph No.
Fire Support/Army Tactical Fire Support (TACFIRE)	1.2.1
Fire Support/Naval Gunfire Support	1.2.2
Fire Support/Marine Integrated Fire and Air Support System (MIFASS)	1.2.3
Air Defense/Short Range Air Defense (SHORAD)	1.2.4
Air Defense/Long Range Air Defense (LORAD)/PATRIOT	1.2.5
Air Defense/Missile Guidance and Control	1.2.6
Close Air Support/Air Request Net (TACP-DASC)	1.2.7
Close Air Support/Helicopter Nap of the Earth (NOE)	1.2.8
Close Air Support/Marine Integrated Fire and Air Support System (MIFASS)	1.2.9
Land Combat/Tactical Operations System (TOS)	1.2.10
Land Combat/"Bare Base" Combat Control Teams (CCT)	1.2.11
Land Combat/Marine Integrated Fire and Air Support System (MIFASS)	1.2.12
Ship-to-Shore/Amphibious Assault/Warfare	1.2.13
Ship-to-Shore/Mine Countermeasures (MCM)/Beacon-Buoy	1.2.14
Air Reconnaissance/Surveillance/RPV/Drone Control and Guidance	1.2.15
Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination	1.2.16

1.2.1 Fire Support/Army Tactical Fire Support (TACFIRE). This paragraph describes the various mission constraints that are applicable to users operating in a TACFIRE environment. In this analysis, the quantity of participants are those representative of a typical Army mechanized division. Although participant quantities are shown as typical of a division, it should be remembered, for planning purposes, that at present the Army has 16 divisions, but it can be expected for future planning that equipment quantities should be based on 24 divisions plus a float factor. Table 1.2.1-1 depicts the mission constraints that are applicable to specific users operating in a TACFIRE environment in a typical Army mechanized division.

Table 1.2.1-1. Fire Support/Army Tactical Fire Support (TACFIRE)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. X	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
FSE (DTOC)	1			X					X		Truck				B	VD	VFMED/TACFIRE	+	N	N	N
Div Arty FDC	1			X					X		Truck Mtd Shelter			1D	B	VD	Computer/TACFIRE	+	N	N	N
DS Bn (155mm, SP)	3		X					X			Truck Mtd Shelter			6H	C	VD	Computer/TACFIRE	+	N	N	N
DS Btry	9		X				X				Carrier, PP			6H	C	VD	BDU/TACFIRE	+	N	N	N
FO	36	X				X							Truck		C	VD	DMD/TACFIRE	−	N	N	N
GS Bn (8 in., SP)	1			X					X		Truck			6H	B	VD	Computer/TACFIRE	+	N	N	N
GS Btry	3		X					X			Carrier, PP			6H	B	VD	BDU/TACFIRE	+	N	N	N
FSO (Bde)	3			X				X			Carrier, PP				B	VD	VFMED/TACFIRE	+	N	N	N
FSO (Bn)	9		X				X					Carrier, PP			B	VD	VFMED/TACFIRE	+	N	N	N
AO	2	X				X					Helicopter				A	VD	DMD/TACFIRE	−	Y	N	N
Tgt Acq Btry	1		X						X		Truck				B	VD	DMD + BDU/TACFIRE	+	N	N	N
FIREFINDER RS (Div Arty) TPQ-37	2			X					X		Truck Mtd Shelter				C	VD	Computer/FIREFINDER	+	N	N	N
FIREFINDER RS (Bn) TPQ-36	3		X					X			Truck Mtd Shelter				C	VD	Computer/FIREFINDER	+	N	N	N
SOTAS MS	1			X					X		Truck Mtd Shelter				C	VD	Computer/SOTAS	+	N	N	N
RPV GCS (Div Arty)	1			X					X		Truck Mtd Shelter				C	VD	Computer/RPV	+	N	N	N
RPV GCS (Bde)	3			X				X			Truck Mtd Shelter				C	VD	Computer/RPV	+	N	N	N
REMBASS MS (Div)	1			X					X		Truck Mtd Shelter				C	VD	Computer/REMBASS	+	N	N	N
REMBASS MS (Bde)	3			X				X			Truck Mtd Shelter				C	VD	Computer/REMBASS	+	N	N	N
FAMAS WS	1			X					X		Truck Mtd Shelter				C	VD	Computer/FAMAS	+	N	N	N

Table 1.2.1-1 (Cont'd)

Notes:

1. It is expected that the BDU will eventually be replaced by the Battery Computer System (BCS).
2. Although it is indicated that there is both voice and data traffic, with the use of the TACFIRE system data transmission is predominant. Voice would be used as a backup and for command and control functions.

1.2.2 Fire Support/Naval Gunfire Support. This paragraph describes the various mission constraints that are applicable to users engaged in providing naval gunfire support. Naval gunfire support, including the employment of guns, rocket launchers, and guided missiles, is delivered by ships' batteries to support troop and related surface and air operations. Generally, the firing batteries of heavy and light cruisers and destroyers are employed with cruisers operating in general support of a brigade or higher sized unit and destroyers operating in direct support of battalion size units. The ships usually standoff 5 to 7 miles from the objective area and are assigned specific zones in which they will fire. To coordinate the naval gunfire support with the ground forces an Air and Naval Gunfire Liaison Company (ANGLICO) is attached to a divisional size unit. Dependent upon the size of the operation and the size of the ground force employed, the entire ANGLICO or portion of it may be employed. The organization of the ANGLICO is such that portions are employed at the various ground force echelons (e.g., battalion, brigade, and division). Task organized control and liaison teams/parties are assigned to the various ground force echelons to advise on capabilities, limitations, and employment of naval gunfire and/or naval air support. The ANGLICO provides the necessary personnel, communications, and equipment required at the various echelons to provide the required naval gunfire support. Table 1.2.2-1 depicts the organizational users in the naval gunfire support mission and specifies the applicable mission constraints as known. The quantities of participants specified here are for an entire ANGLICO supporting a divisional size unit. The Naval Gunfire Support teams

generally operate collocated with the fire support elements at the various group force echelons. The designation in parentheses with the participant, indicates the echelon at which the participant operates.

Table 1.2.2-1. Fire Support/Naval Gunfire Support

Participant/Facility	Quantity	Terrain Use			Threat Proximity Zone						Mobility					Voice/ Data	System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphic Display
											Vehicle Utilization			Freq. of Movement	Operations on Move						
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S					Pos.	Nav.		
ANGLICO	1			X						X		Truck			C	V		+	N	N	Y
Div Air/NGF Platoon	1			X					X			Truck			B	V		+	N	N	Y
TACP (Div)	1			X					X			Truck			C	V		+	N	Y	Y
NGF Team (Div)	1			X					X			Truck			C	V		+	N	N	Y
Bde Air/NGF Platoon	3		X					X				Truck			C	V		+	N	N	Y
TACP (Bde)	3		X					X				Truck			B	V		+	N	Y	Y
NGF Team (Bde)	3		X					X				Truck			B	V		+	N	N	Y
TACP (Bn)	9		X				X					Truck			B	V		+	N	Y	Y
SFCP (Bn)	6		X				X						Truck		B	V		+	N	Y	Y
ALP (Bn)	9		X				X					Truck			B	V		+	N	Y	Y
FACP (Bn)	9	X				X							Truck		B	V		+	N	Y	Y
NGLP (Bn)	6		X				X						Truck		B	V		+	N	N	Y
NGST (Bn)	6	X				X							Truck		B	V		+	N	Y	Y
Cruisers	V									X	Cruiser			A	A	V		+	Y	Y	Y
Destroyers	V									X	Destroyer			A	A	V		+	Y	Y	Y

Table 1.2.2-1 (Cont'd)

Notes:

1. The NGLP (Bn) has a Naval Gunfire Liaison Officer (NGLO) as do the organizations at the other various echelons of the ground force.

2. The NGST (Bn) has Naval Gunfire spotters assigned to it.

3. The quantities of cruisers and destroyers employed will be dependent upon the particular mission.

4. Terrain use constraints are not applicable to the cruisers and destroyers.

5. The threat proximity zone for the naval ships is shown as "E" but those ships will usually stand-off 5 to 7 miles from the objective area.

6. At present, all transmission are by voice.

7. It is assumed that personnel of the ANGLICO possess required vehicles to allow for movement with the ground force echelons.

8. No system has been identified that is used for Naval Gunfire Support, therefore, there are no system interfaces shown.

9. It is assumed that the teams of the ANGLICO cannot complete all mission actions while on the move.

10. It is assumed that position location to the nearest meter is necessary to provide accurate positioning for determining target locations.

11. If JTIDS Class 1 of 2 equipment were installed on Naval close air support aircraft or gunfire flatforms, all ANGLICO participants would have a requirement for interoperability with the JTIDS Class 1 and 2 equipments. This is true since requests and fire coordination can involve any echelon.

12. Since no system has been identified for use with Naval Gunfire Support, a graphic display with the Class 3 terminal would be beneficial.

1.2.3 Fire Support/Marine Integrated Fire and Air Support System (MIFASS). This paragraph describes the various mission constraints that are applicable to the users of a Marine Force operating with MIFASS. MIFASS is a command and control system designed to optimize the utilization of fire and air support assets within a Marine Air Ground Task Force (MAGTF). For this mission profile, it is assumed that the Marine Force is a divisional size unit operating with Naval Gunfire Support and Tactical Air Support. Position location is provided for with MIFASS by employment of the Position/Locating Reporting System (PLRS). Table 1.2.3-1 depicts the mission constraints that are applicable to specific users in a MIFASS environment.

Table 1.2.3-1 Fire Support/Marine Integrated Fire and Air Support System (MIFASS)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
FASS (MAF)	1			X						X			Truck		C	VD	Computer, Display Sta, Printer/MIFASS	+	N	Y	N
FASC (Div)	1			X					X			Truck and Shelter			C	VD	Computer, Display Sta, 1 Printer/MIFASS	+	N	Y	N
FASC (Regt)	3			X				X				Truck MTD Shelter			C	VD	Computer, Display Sta, 1 Printer/MIFASS	+	N	Y	N
FASC (Bn)	9		X				X						Truck		C	VD	Computer, Display Sta, 1 Printer/MIFASS	+	N	Y	N
Force Arty Btry	3		X					X					Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N
FDC (Arty Regt)	1			X					X			Truck and Helo			C	VD	Computer, Display Sta, 1 Printer/MIFASS	+	N	Y	N
FDC (Arty Bn)	3		X					X					Truck		C	VD	Computer, Display Sta, 1 Printer/MIFASS	+	N	Y	N
Arty Btry (DS)	9		X				X						Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N
81mm Mortar Plt	9	X				X							Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N
Observers	96	X				X							Trk/Helo		C/A	VD	DMD/MIFASS	−	N	Y	N
NGF Ship	V			X						X			Ship	A	A	VD	DMD + Printer/MIFASS	+	N	Y	N
TACC	1			X						X			Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N
TAOC	1			X						X			Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N
ASRT	3		X				X						Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N
Arty Btry (GS)	3		X					X					Truck		C	VD	DMD + Printer/MIFASS	+	N	Y	N

Table 1.2.3-1 (Cont'd)

NOTES:

1. The quantity of naval ships that will provide Naval Gunfire Support will vary with the operational mission.

2. The Marines have specified that voice is required in addition to the transfer of data. Although some voice communications have been replaced by digital data communications, voice is still required at all echelons of MIFASS.

3. Truck mounted shelters are also capable of being transported by helicopter.

4. Marines have specified that the class 3 terminal must be small enough to be man transportable.

5. The position location accuracy of 10 meters is the accuracy provided by PLRS.

6. No navigational requirements are indicated since PLRS provides a navigation capability.

7. PLRS equipment is collocated with MIFASS equipment at the various echelons.

Table 1.2.3-1 (Cont'd)

8. JTIDS interoperability would be required for ground users to communicate with aircraft that may employ the Class 1 or Class 2 terminals.

9. Since MIFASS has its own graphics display, no display would be required with the Class 3 terminal.

1.2.4 Air Defense/Short Range Air Defense (SHORAD). This paragraph describes the various mission constraints that are applicable to users engaged in providing short range air defense. Short range air defense is provided by quick-reacting weapons designed to counter that portion of the very low-altitude air threat. This role is currently filled by chaparral and Vulcan, providing low-altitude forward area air defense, and REDEYE , the man-portable air defense system, used by deployed forward elements. Forward area alert radars (FAAR) are organic to the chaparral/Vulcan battalions. The FAAR's are short-range, low-altitude air defense radars used to provide alerting and tentative identification data to SHORAD units. The nature of the threat, especially that of missiles and high performance aircraft, requires that the air defense artillery be capable of rapid response to that threat. It is essential that alerting information be provided in near real-time to permit the fire units time to respond effectively to the threat. Since we are dealing with short range air defense, we are primarily concerned with the air defense assets of division, brigade, and battalion sized units. Air defense of the division area is provided by organic, attached, or supporting air defense organizations, REDEYE air defense weapons, and individual and crew-served automatic weapons. For this mission profile, the SHORAD participants operating in a typical Army mechanized division are considered. A division interface with long range air defense (LORAD) units is required to provide for alerting information from those sources. In this mission profile, an interface with an improved Hawk Bn is considered to provide air defense data derived from other air surveillance sources. The Airspace

control element (ACE) at the DTOC is the focal point for airspace control and includes the ADA capabilities. At Brigade and Battalion levels, Air Defense officers are appointed to control and coordinate air defense resources. Table 1.2.4-1 depicts the SHORAD users operating in a typical Army mechanized division with applicable mission constraints denoted. As depicted, Table 1.2.4-1 shows only the Divisional SHORAD. There will also be non-divisional SHORAD employed behind the division area with the fielding of the ROLAND. Table 1.2.4-2 depicts the users in the non-divisional SHORAD environment. These SHORAD assets will be employed to provide defense for high value assets such as logistics complexes and airbases in the rear area. When possible, one ROLAND battalion is assigned a mission in support of the corps, or may be assigned or attached to a corps when the corps is operating independently. In all probability there will be an interface between the SHORAD ADA Group and the LORAD ADA Group for the interchange of AD information.

Table 1.2.4-1 Air Defense/Short Range Air Defense (SHORAD) Divisional

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
IH Bn	1			X					X		Truck w/ Shelter				B	VD	Computer/G-73	+	N	N	N
ADA Bn	1			X					X				Truck		C	VD		+	N	N	Y
Chaparral Btry	2			X				X					Truck		C	VD		+	N	N	Y
Chaparral Plt	6		X					X					Truck		C	VD		+	N	N	Y
Chaparral FU	24		X				X					Carrier,GM			C	VD		+	N	N	Y
FAAR	12		X				X					Truck			C	VD		+	N	N	Y
Vulcan Btry	2			X				X				Carrier,PP			C	VD		+	N	N	Y
Vulcan Plt	6		X					X				Carrier,PP			C	VD		+	N	N	Y
Vulcan FU	24		X				X					Carrier,Gun			C	VD		+	N	N	Y
DTOC (ACE)	1			X					X		Truck w/ Shelter				C	VD		+	N	N	Y
Bde (BASE)	3			X				X				Truck w/ Shelter			C	VD		+	N	N	Y
Maneuver Bn ADO	9		X				X					Carrier,PP			C	VD		+	N	N	Y
Maneuver Bn AD Tm	45	X				X							Truck		C	VD		+	N	N	Y
ACS ADO	1	X			X							Carrier,PP			C	VD		+	N	N	Y
ACS AD Tm	5	X			X								Truck		C	VD		+	N	N	Y
Arty DS Bn ADO	3		X					X					Truck		C	VD		+	N	N	Y
Arty DS Bn AD Tm	9		X				X						Truck		C	VD		+	N	N	Y
Arty GS Bn ADO	1		X						X				Truck		C	VD		+	N	N	Y
Arty GS Bn AD Tm	3		X					X					Truck		C	VD		+	N	N	Y

Table 1.2.4-1 (Cont'd)

Notes:

1. With changes that are occurring in the configuration of division assets, it is expected that the Airspace Coordination Element (ACE) designation will be replaced by the Division Airspace Management Element (DAME).
2. A current division has an ADA Bn consisting of 2 chaparral and 2 Vulcan batteries. It is expected that in the near future this battalion will be replaced by a SHORAD Bn consisting of 1 battery of ROLAND (in general support of the division with 3 platoons of 4 fire units each) and 3 batteries of DIVAD Gun (in direct support of each brigade with each battery leaving 3 platoons of 4 fire units each). It is also expected that the REDEYE assets will be replaced by the STINGER.
3. At battalion level, the REDEYE section leader is normally appointed as the battalion air defense officer.
4. In the maneuver battalions REDEYE sections, 2 teams are mounted and 3 teams are dismounted. In the Armored Cavalry Squadron REDEYE section, 2 teams are mounted and 3 teams are dismounted. In the artillery battalions AD sections, all three teams are dismounted.
5. For the Armored Cavalry Squadron, the terrain use and threat proximity indicated is based on the Squadron being deployed as a covering force for the division with its units deployed forward of the FEBA maning the general outpost. The Armored Cavalry Squadron could be employed in other roles (e.g., flanking force, reserve, etc.) in which cases these two constraints would differ.

6. With the exception of the Improved Hawk Battalion which employs the AN/TSQ-73, no other data systems are identified with the users in SHORAD.

7. Since there is no system identified with the SHORAD users, a graphic display may be desirable.

8. For SHORAD operations, communications is predominantly by voice.

9. Based on previous analyses, the Air Defense School sees no requirement for Class 3 manpack terminals for internal ADA data communications.

Table 1.2.4-2 Air Defense/Short Range Air Defense (SHORAD) Non-Divisional

Participant/Facility	Quantity	Terrain Use			Threat Proximity Zone						Mobility					Voice/ Data	System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphic Display
											Vehicle Utilization			Freq. of Movement	Operations on Move						
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S					Pos.	Nav.		
LORAD ADA Group	1			X						X	Truck and Shelter				B	VD	Computer/G-73	+	N	N	N
SHORAD ADA Group	1			X						X	Truck and Shelter				a	VD		+	N	N	Y
ROLAND Bn	4			X						X	Truck				C	VD		+	N	N	Y
ROLAND Btry	16			X						X	Truck				C	VD		+	N	N	Y
ROLAND FU	144			X						X	Carrier, Gen.				C	VD		+	N	N	Y

Table 1.2.4-2 (Cont'd)

Notes:

1. Although the ROLAND battalion is depicted as being four per SHORAD ADA Group, the Group may be composed of two to four ROLAND battalions consisting of four batteries of nine ROLAND fire units each.
2. With the exception of the LORAD ADA Group which employs the AN/TSQ-73, no other data systems are identified with the users in SHORAD. Since there is no system identified, a graphic display may be desirable.

1.2.5 Air Defense/Long Range Air Defense (LORAD)/PATRIOT. This paragraph describes the various mission constraints that are applicable to users engaged in providing long range air defense. LORAD assets complement the SHORAD assets by providing low-to-medium-altitude air defense (LOMAD) and high-to-medium-altitude air defense (HIMAD). In this mission profile, two different sets of assets are considered, the Improved Hawk which is now employed by the Army, and the PATRIOT which is expected to be fielded in the near future. The PATRIOT will eventually replace the Improved HAWK, but in the interim, there may exist Improved HAWK, PATRIOT and/or combinations of both. The Improved HAWK is discussed first and then followed by a discussion of PATRIOT. Improved HAWK battalions are normally deployed under ADA group control. The primary role of the Improved HAWK is to provide area air defense coverage of ground combat forces and to provide defense of high value rear assets such as logistics complexes, strike bases and ports. This will require Improved HAWK units to be positioned in the rear of divisions, in the corps area to the rear of the division boundaries, and at other selected rear area locations. Improved HAWK is found in one or two organizational configurations, TRIAD (triangular) or conventional (square). The TRIAD battalion contains nine independently deployed firing platoons organized into three batteries of three platoons each. The conventional battalion contains eight such firing platoons organized into four batteries of two platoons each. Three to five Improved HAWK battalions are organized into ADA groups. The ADA group may be assigned a theater general support mission, may be assigned or attached to a corps when the corps is operating

independently, or may be assigned a mission in support of the corps in a larger theater operation. Generally, one Improved HAWK battalion is in direct support to each committed division, and one Improved HAWK battalion is in general support to the corps. The ADA group is equipped with the AN/TSQ-73 air defense command and control system as are the Improved HAWK battalions. The group AN/TSQ-73 interfaces directly with the Air Force control and reporting center (CRC) to obtain supplemental information from Air Force sensors such as the E-3A (AWACS). An Improved HAWK battalion can perform in an autonomous mode and a battalion may be designated as a master battalion and may interface directly with the CRC. Table 1.2.5-1 depicts the LORAD users operating with Improved HAWK capability and the mission constraints that are applicable to the particular users. For this particular table, it is assumed that the ADA group is composed of three TRIAD battalions. An interface would also exist between the LORAD assets and the SHORAD assets employed at division level for interchange of AD information. This interface would probably be through the ACE at the DTOC.

Table 1.2.5-1 Air Defense/Long Range Air Defense (LORAD)/Improved HAWK

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
AF CRC	1			X						X	TRUCK MTD SHELTER				C	VD	AF Computer/TSQ-91	+	N	Y	N
ADA Group	1			X						X	TRUCK MTD SHELTER				C	VD	Computer/Q-73	+	N	Y	N
CTOC (ACE)	1			X						X	TRUCK MTD SHELTER				B	VD		+	N	Y	Y
IH Bn	3			X					X	X	TRUCK MTD SHELTER				C	VD	Computer/Q-73	+	N	Y	N
IH Btry	9			X					X	X	TRK/SP				C	VD	BTE/Q-73	+	N	Y	N
IH Platoon	27			X					X	X	TRK/SP				C	VD	CTE/Q-73	+	N	Y	N
DTOC (ACE)	3			X					X		TRUCK MTD SHELTER				B	VD		+	N	Y	Y

Table 1.2.5-1 (Cont'd)

Notes:

1. Improved HAWK assets are shown in threat proximity zones D and E since some of the IH units will be deployed in the rear of the division zone and others in the corps zone.
2. For vehicle utilization, Improved HAWK batteries and platoons operating in the rear of the division area are in self-propelled missile carriers, while those operating in the corps area are truck mounted.
3. Based on previous analyses, the Air Defense School sees no requirement for Class 3 manpack terminals for internal ADA data communications.

PARTIOT battalions are also normally deployed under ADA group control. The primary role of PATRIOT is identical to that of the Improved HAWK and the normal positioning of PATRIOT units is also identical to the Improved HAWK. Three to five PATRIOT battalions will be organized into ADA groups. The ADA group will generally provide a minimum of three PATRIOT firing platoons to cover each committed division, and six to twelve PATRIOT firing platoons to cover the corps from the rear of the division to the corps rear boundary. A PATRIOT battalion is organized into 3 batteries with 2 platoons (engagement control station) of 5 launching groups. The ADA group is equipped with the AN/TSQ-73 as are the PATRIOT battalions. The group AN/TSQ-73 interfaces directly with the Air Force CRC to obtain supplemental information from Air Force sensors. Direct control and supervision of PATRIOT firing platoons is exercised at the PATRIOT battalion level Command and Control Group (CCG). The CCG provides the interface with the group AN/TSQ-73. The PATRIOT battalion can perform in an autonomous mode and a battalion may be designated as a master battalion and may interface directly with the CRC. Table 1.2.5-2 depicts the LORAD users operating with PATRIOT capability and the mission constraints that are applicable to the particular users. For this particular table, it is assumed that the ADA group is composed of four PATRIOT battalions. An interface would also exist between the LORAD assets and the SHORAD assets employed at division level for interchange of AD information. This interface would probably be through the ACE at the DTOC.

Table 1.2.5-2 Air Defense/Long Range Air Defense (LORAD)/PATRIOT

Participant/Facility	Quantity	Terrain Use			Threat Proximity Zone						Mobility					Voice/ Data	System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphic Display
											Vehicle Utilization			Freq. of Movement	Operations on Move						
		Cat. 1	Cat. 2	Cat. 3	?	A	B	C	D	E	Cat. X	Cat. U	Cat. S					Pos.	Nav.		
AF CRC	1			X						X	TRUCK MTD SHELTER				C	VD	AC Computer/TSQ-91	+	N	Y	N
ADA Group	1			X						X	TRUCK MTD SHELTER				C	VD	Computer/Q-73	+	N	Y	N
CTOC (AFE)	1			X						X	TRUCK MTD SHELTER				B	VD		+	N	Y	Y
PATRIOT Bn CCG	4			X						X	TRUCK MTD SHELTER				C	VD	Computer/Q-73	+	N	Y	N
PATRIOT Btry	12			X					X	X	TRUCK				C	VD	BTE/Q-73	+	N	Y	N
PATRIOT Plt (ECS)	24			X					X	X	TRUCK				C	VD	BTE/Q-73	+	N	Y	N
PATRIOT LG	120			X					X	X	TRUCK				C	VD	BTE/Q-73	+	N	Y	N
ZTOC (ACL)	3			X					X		TRUCK MTD SHELTER				B	VD		+	N	Y	Y

Table 1.2.5-2 (Cont'd)

Notes:

1. PATRIOT assets are shown in threat proximity zones D and E since some of the PATRIOT units will be deployed in the rear of the division zone and others in the corps zone.
2. Based on previous analyses, the Air Defense School sees no requirement for Class 3 manpack terminals for internal ADA data communications.

1.2.6 Air Defense/Missile Guidance and Control

This paragraph describes the various mission constraints that are applicable to the users or facilities that operate in the environment of missile guidance and control. The Navy's primary concern is the passing of anti-aircraft data and control from one platform to another. That is the ability to acquire and track a target from one ship, launch a missile from another ship and possibly even control the intercept from a third ship. Such an application would probably involve primarily Class 1 and Class 2 terminals, however, a Class 3 terminal could be used in the anti-aircraft missile itself if space, weight, cost and ruggedization make it practical. We must remember, that with detonation of the missile, we lose all equipment associated with the missile including the Class 3 terminal if it is an integral part of the missile. For air defense purposes, we must have the capability to track enemy launched missiles as well as the enemy platforms from which such missiles were launched. Constant exchange of data is required to provide effective handoff (transfer of control) and positioning update information from one participant to another to provide for effective tracking. The prime participants in this profile are the shipboard and airborne platforms which are used in the detection and tracking of enemy targets, the launch platform from which our missile is launched, the command and control (C^2) center which is the controlling platform for tracking and guidance of the missile, the missile itself, and any other slave aircraft or shipboard platform that may be employed to assist in providing tracking information to the C^2 center. With the exception of the missile itself, which will come in

direct contact with the enemy weapon or enemy launch platform, all participants will be at some distance from the enemy. Based on information provided with the mission profile description, the type of missile employed will dictate the physical distance involved. Missile range capabilities from the launch platform can vary from 35 to 120 miles or even greater, if the TOMAHAWK is employed. Many of the participants are located some distance from the enemy and can make maximum use of communications. Their location places them well away from the enemy in threat proximity Zone E or greater. In this profile, all participants operate completely from their shipboard or airborne platforms and are constantly on the move. It is assumed that all airborne platform participants and possibly even shipboard platform participants will employ the Class 1 or Class 2 terminal thus requiring JTIDS interoperability with the Class 3 terminal to be employed by the missile. Anti-jam features become critical here since the missile will be subjected to enemy ECM and uninterrupted communications for guidance is mandatory. There would be no need for voice in the Class 3 terminal since only data would be transmitted between the missile and control elements. Graphics display capability would be unncessary. Position location accuracy was not stated in the profile description but it is assumed that it would be greater than 30 meters. Navigational requirements are critical to insure accurate tracking, target location, and missile guidance.

1.2.7 Close Air Support/Air Request Net (TACP-DASC)

This paragraph describes the various mission constraints that are applicable to users operating in the air support request channels for Air Force support. Close air support is the attack by air against hostile targets which are close to friendly forces and which require detailed integration of each air mission with the fire and movement of these forces. To control tactical air strikes in the battle area it is necessary that forward air controllers (FAC) are capable of intercommunicating with the strike aircraft as well as with the ground force they support and the Tactical Air Control Party (TACP) to which they belong. Intercommunications between air controlling elements at all echelons as well as the attached Air Force liaison and control facilities is also necessary. Requests for close air support can be initiated at any level of command. These requests can be either immediate or preplanned. Preplanned requests are handled through command channels of the ground force and ultimately gets into Air Force channels through the Army liaison element at the Air Force tactical air control center (TACC) located in the corps area. The TACC assigns sorties and notifies the direct air support center (DASC) which is collocated with the tactical air support element (TASE), the G3/air representatives of the ground force, in the CTOC. The TASE sends pertinent information to appropriate subordinate units and TOC elements (e.g., ACE) concerned. Control of the air strike missions is then handled via Air Force channels and between the aircraft and the air controllers when the mission is flown. Immediate requests are handled differently. Below battalion level, they are sent to the battalion Fire Support Coordination Center (FSCC). Each request is

validated and then passed to the battalion Tactical Air Control Party (TACP). The TACP transmits the request directly to the DASC over the Air Force air request net. The TACPs at intermediate Army echelons monitor the transmission and acknowledge to the DASC that the request has been received. At all echelons the request is coordinated for approval with the appropriate ground force element. Final approval, when received at the DASC, authorizes issuance of orders to fly the mission. The DASC provides all pertinent air mission data to the TASE for its use and further dissemination in Army channels. Control of the air strike mission is then handled via Air Force channels and between the aircraft and the air controllers when the mission is flown. In this mission profile, the participants shown are the Air Force and Army users at the various echelons for a corps with four divisions and each brigade with five battalions. Table 1.2.7-1 depicts the various mission constraints that are applicable to the particular users. According to information received at the Air Force users meeting held in August 1977, there will be one ground FAC per maneuver battalion and probably an air FAC operating in support of each brigade.

Table 1.2.7-1 Close Air Support/Air Request Net (TACP-DASC)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
TACC (AF)	1			X						X	TRUCK MTD SHELTER				C	VD		+	Y	Y	Y
TUOC (AF)	1			X						X			TRUCK		C	VD		+	Y	Y	Y
DASC (AF)	1			X						X	TRUCK MTD SHELTER				C	VD		+	Y	Y	Y
CTOC/TASE (Army)	1			X						X	TRUCK MTD SHELTER				B	VD	Computer/TACFIRE	+	Y	Y	N
DTOC/TASE (Army)	4			X					X		TRUCK MTD SHELTER				B	VD	VFMED/TACFIRE	+	Y	Y	N
TACP (DIV) (AF)	4			X					X		TRUCK MTD SHELTER				C	VD		+	Y	Y	Y
FSCC (BDE) (Army)	12			X				X			TRUCK MTD SHELTER				B	VD	VFMED/TACFIRE	+	Y	Y	N
TACP (BDE) (AF)	12			X				X			TRUCK MTD SHELTER				C	VD		+	Y	Y	Y
AFAC (BDL)(AF)	12	X				X					Aircraft				A	VD		—	Y	Y	Y
FSCC (BN) (Army)	60		X				X					Carried on			B	VD	VFMED/TACFIRE	+	Y	Y	N
TACP (BN) (AF)	60		X				X					TRUCK			C	VD		+	Y	Y	Y
GFAC (BN) (AF)	60	X				X							TRUCK		C	VD		—	Y	Y	Y
CO CMDR (Army)	180	X				X							TRUCK		C	VD		+	Y	Y	Y

Table 1.2.7-1 (Cont'd)

NOTES:

1. It is assumed that Air Force personnel at the various echelons will possess the required vehicles to be as mobile as the echelon headquarters which they are supporting. It is further assumed, that at echelons where shelters are employed, Air Force personnel will be housed in shelters so as to be collocated with ground force counterparts.

2. Since navigation aid requirements exist for the AF users, it is assumed that the Army counterparts will also have the same requirement.

3. JTIDS interoperability would be required in order to intercommunicate with strike aircraft having Class 1 or Class 2 terminals.

4. For those users where system interfaces are not indicated, a graphic display may be desirable.

1.2.8 Close Air Support/Helicopter Nap of the Earth (NOE)

This paragraph describes the various mission constraints that are applicable to participants involved in rotary-wing close air support. The commander is able to more fully exploit his firepower capabilities through the employment of Army aircraft to deliver area and point target fire and observe and adjust fires. The attack helicopter provides a standoff antitank, antibunker, antipersonnel weapon system which augments the commander's capability to deliver selective, responsive, accurate, and discriminating fires in the accomplishment of his mission. Through the use of the observation helicopter, the commander is provided with a highly mobile platform to acquire and designate targets and to adjust both his aerial and ground fires. The unique fire and maneuver capability of attack helicopter units allows them to deny and dominate key terrain and major avenues of approach in the battlefield. The first cardinal rule in minimizing vulnerability to enemy fire is proper use of concealment and cover. For this reason, Army aircraft employs nap-of-the earth (NOE) methods. NOE operation is the tactic of employing aircraft in such a manner as to utilize the terrains, vegetation, and man-made objects to enhance survivability by degrading the enemy's ability to visually, optically, or electronically detect or locate the aircraft. NOE flight is as close to the earth's surface as vegetation or obstacles will permit, while generally following the contours of the earth. Airspeed and altitude are varied as influenced by the terrain, weather, ambient light, and enemy situation. When conducting NOE flying, communications will often be limited or restricted due to interference with

line-of-sight imposed by terrain features. In addition to communications and control, identification of friendly aircraft by friendly air defense and ground units is necessary. Terrain flight navigation becomes extremely difficult when employing NOE because the aviator navigates primarily by vertical relief. NOE navigation requires continuous orientation to provide for collision avoidance. Coordination of actions of attack helicopters with the ground forces they are supporting is necessary as is the transfer of information between cooperating aircraft, such as handoff of targets from scout ships to gun ships. Since we are dealing here with close air support that can be provided by organic Army aircraft, the AF elements, such as the TACP, which are participants in close air support for tactical aircraft would not be participants here except for coordination. We are concerned here with the control facilities of the various Army echelons and the units which have observation and attack helicopters which may be employed in close air support missions. Like close air support for tactical air, requests for armed helicopter support are handled in specific ways. Any level can initiate requests for such support. These requests are either immediate or preplanned. Requests are satisfied at the lowest echelon possessing the organic, attached, or supporting aircraft capable of fulfilling the requestor's needs. Requests for preplanned armed helicopter support are submitted to the fire support coordination center at battalion and brigade level or the tactical operations center at division and higher echelons. They form the basis for the armed helicopter support plan. If the requests are not within the capability of aerial resources immediately available, requests are consolidated, assigned a priority, and forwarded to

the next echelon of command. Immediate requests below battalion level are forwarded to the battalion command post by the most rapid means available. At battalion level, requests are validated by the commander or his representative and forwarded to brigade or division. Brigade or division satisfies the request from organic, attached, or supporting aircraft resources or forwards the request to the next higher echelon. The Air Cavalry Troops of the Armored Cavalry Squadrons, in addition to possessing helicopters with a prime mission of air reconnaissance, also possess attack helicopters which may be employed in close air support roles. For this mission profile, participants are for a corps with four mechanized divisions and brigades with five battalions. In addition there is an Attack Helicopter Battalion and an Assault Helicopter Battalion assigned to the Corps to provide close air support missions. Table 1.2.8-1 depicts the various mission constraints that are applicable to the particular users.

Table 1.2.8-. Close Air Support/Helicopter Nap of the Earth (NOE)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
Corps Elements:																					
CTOC/TASE	1			X							TRUCK AND SHELTER				B	VD	Computer/TOS	+	Y	N	N
Attack HCPTR Bn:	1			X								TRUCK			B	VD		+	Y	N	Y
Observation HCPTR	36	X			X	X					HCPTR				A	VD		+	Y	N	Y
Attack HCPTR	63	X			X	X					HCPTR				A	VD		+	Y	N	Y
Assault HCPTR Bn:	1			X								TRUCK			B	VD		+	Y	N	Y
Observation HCPTR	3	X			X	X					HCPTR				A	VD		+	Y	N	Y
Attack HCPTR	12	X			X	X					HCPTR				A	VD		+	Y	N	Y
ACR Air Cav Troop:	1	X			X							TRUCK			B	VD		+	Y	N	Y
Observation HCPTR	10	X			X	X					HCPTR				A	VD		+	Y	N	Y
Attack HCPTR	9	X			X	X					HCPTR				A	VD		+	Y	N	Y
Division Elements:																					
DTOC/TASE	4			X					X		TRUCK AND SHELTER				B	VD	Computer/TOS	+	Y	N	N
ACS Air Cav. Troop:	4	X			X							TRUCK			C	VD		+	Y	N	Y
Observation HCPTR	40	X			X	X					HCPTR				A	VD		+	Y	N	Y
Attack HCPTR	36	X			X	X					HCPTR				A	VD		+	Y	N	Y
FSCC (BDE)	12			X				X			TRUCK AND SHELTER				B	VD	TCS/TOS VEHICLE/INTERFACE	+	Y	N	N
FSCC (BN)	60		X				X					Carrier, CP			B	VD	TCT/TOS JTMED/INTERFACE	+	Y	N	N
CO COMDR	180	X				X							TRUCK		C	VD		+	Y	N	Y

Table 1.2.8-1 (Cont'd)

NOTES:

1. Although the divisions possess more observation helicopters than shown as participants, the ones shown are those most likely to be directly associated with CAS operations. To give some idea of the other observation helicopters available, the following organic capabilities are shown:

Unit	Quantity of Observation Helicopters
Div Arty Aviation Section	14
BDE Aviation Section	4
Div Aviation Company	6

2. There are also a vast quantity of utility helicopters which could be used in CAS operations, particularly those possessed by the Assault Helicopter Battalion which are armed helicopters. The units having these are shown as follows:

Unit	Quantity of Observation Helicopters
Attack Helicopter Bn	6
Assault Helicopter Bn	60
Air Cavalry Troup	8
Div Avn Co.	4

3. The ACR and ACS Air Cavalry Troops are shown in terrain use Category 1 and threat proximity Zone F based on their normal mission of operating as a covering force. In other deployments, these factors would change.

4. Observation and attack helicopters are shown in threat proximity zones F and A because they may be operating in either area.

5. JTIDS interoperability with Class 1 and 2 terminals is not required specifically for the helicopter mission, however, an airspace coordination net in which both Army and Air Force aircraft participate would make interoperability necessary.

6. Graphic Display capability may be desirable, particularly as a cockpit display in the aircraft.

7. Navigation is critical to NOE operations and would be required.

1.2.9 Close Air Support/Marine Integrated Fire and Air Support System (MIFASS)

MIFASS is a command and control system designed to optimize the utilization of fire and air support assets within a Marine force. This combines the operations of fire support and close air support into one integrated system. The prime users of the system for close air support would be the same as those using the system for fire support coordination and control. Therefore, the mission constraints identified in paragraph 1.2.3 for fire support operations are equally applicable in the MIFASS environment for close air support.

1.2.10 Land Combat/Tactical Operations System (TOS)

This paragraph describes the various mission constraints that are applicable to users operating in a TOS environment. TOS is designed to provide commanders and staff with the depth of battlefield vision that is necessary to insure success on the modern battlefield. Extensive knowledge of the location and status of friendly and enemy forces will provide the ability to maximize the employment of available resources. For this mission profile, the quantity of participants are based on a corps with 4 divisions and a separate brigade. The divisions are based on the new anticipated configuration with each brigade having 5 maneuver battalions. The locations of users are based on the latest developed configuration for TOS. Table 1.2.10-1 depicts the mission constraints that are applicable to the specific users operating in a TOS environment.

Table 1.2.10-1. Land Combat/Tactical Operations System (TOS)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces		Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
Corps Elements:																						
CTOC:	1			X						X	Truck and Shelter				B	VD	CGC/TCS	TOS	+	N	N	N
INTEL Element	1			X						X	Truck and Shelter				B	VD	TCS/TDS	TOS	+	N	N	N
OPS Element	1			X						X	Truck and Shelter				B	VD	TCS/TDS	TDS	+	N	N	N
BCC	1			X						X	Truck and Shelter				B	VD	TCS/TDS	TOS	+	N	N	N
CORPS MAIN	1			X					X		Carrier, CP				B	VD	TCS/TDS	TDS	+	N	N	N
COSCOM	1			X						X	Truck and Shelter				B	VD	TCS/TDS	TDS	+	N	N	N
CORPS Rear	1			X						X	Truck and Shelter				B	VD	TCS/TDS	TDS	+	N	N	N
ACR	1			X						X	Carrier, CP				B	VD	TCS	TDS	+	N	N	N
ACS	3	X			X						Carrier, CP				B	VD	TCT	TDS	+	N	N	N
Engineer BDE	1			X						X		Truck			B	VD	TCS	TDS	+	N	N	N
Engineer BN	3			X					X			Truck			B	VD	TCT	TDS	+	N	N	N
Separate BDE	1			X				X			Truck and Shelter				B	VD	SBCC/TCS TDS	TDS	+	N	N	N
Maneuver BN	5		X				X					Carrier CP			B	VD	TCT	TDS	+	N	N	N
TACC (BCE)	1			X						X		Trailer			B	VD	TCS	TDS	+	N	N	N
ADA Group	1			X						X	Truck and Shelter				B	VD	Computer/TDS		+	N	N	N
CEWI Group	1			X						X		Truck			B	VD			+	N	N	N

Table 1.2.10-1 Land Combat/Tactical Operations Systems (TOS) (Cont'd)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. A	Vehicle Utilization Cat. U	Vehicle Utilization Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
Divisional Elements:																					
DTOC:	4			X					X		Truck M46 Shelter				P	VD	DCC/TCS TOS	+	N	N	N
INTEL Element	4			X					X		Truck M46 Shelter				B	VD	TCS/TCT/TDS TOS	+	N	N	N
OPS Element	4			X					X		Truck M46 Shelter				B	VD	TDS/TCT TOS	+	N	N	N
TAC CP	4			X				X			Carrier, CP				B	VD	TCS/TCT/TDS TOS	+	N	N	N
DISCOM	4			X					X		Truck				B	VD	TCT TOS	+	N	N	N
BDE	12			X				X			Truck M46 Shelter				B	VD	TCS/TCT TOS	+	N	N	N
Maneuver BN	60		X				X					Carrier, CP			B	VD	TCT TOS	+	N	N	N
ACS	4	X			X							Carrier, CP			B	VD	TCT TOS	+	N	N	N
DIVARTY	4			X					X		Truck M46 Shelter				B	VD	TCT Computer / INCFIRE TOS	+	N	N	N
Engineer BN	4			X					X			Truck			B	VD	TCT TOS	+	N	N	N
ADA BN	4			X					X			Truck			B	VD	TCT TOS	+	N	N	N
Aviation BN/CO	4			X					X			Truck			B	VD	TCT TOS	+	N	N	N
CEWI BN	4			X					X			Truck			B	VD	TCT TOS	+	N	N	N

Table 1.2.10-1 (Cont'd)

Notes:

1. There will be a direct interface between the CTOC computer and WWMCCS.
2. Higher headquarters will either possess a similar computer center to interface with the CCC or will probably be provided with a TCS with display keyboards and a TDS to provide the capability for interchange of data.
3. Each adjacent corps, if it does not possess an equivalent CCC, will probably be provided with a TCS with display keyboards and a TDS to provide for interchange of data.
4. No system interfaces are shown for the CEWI Group. Personnel of this group will operate at the All-Source Analysis Center to provide information from and to the TCAS and MAGIIC systems. Type TOS equipment to be used in the center is unknown at this time but there will be an interface with the CCC.
5. The CEWI battalion at divisional level will provide the interface point for the TCAS.
6. The system interfaces at DivArty are two-fold. There will be a direct interface between the TOS DCC and TACFIRE and there will also be a TCT located at DivArty to provide for command and control type information exchange.
7. The TOS also provides the capability to provide up to 3 TCT that may be used by adjacent NATO and/or multi-national forces for interchange of information with the TOS CCC and/or DCC.

8. The ACSs of the Corps ACR are shown in terrain use category 1 and threat proximity Zone F because of the nature of their normal missions. The normal mission of the ACR is to provide security and perform reconnaissance for the unit to which assigned, and to engage in offensive, defensive, or delaying actions as an economy of force unit. Such missions place the ACSs in close proximity to the enemy. This is also true of the ACS assigned to the division.

1.2.11 Land Combat/"Bare Base" Combat Control Teams (CCT)

This paragraph describes the various mission constraints that are applicable to the combat control teams and supporting ground assault teams that are deployed as an advanced force during airborne operations. Airborne operations are normally a joint effort between the Air Force and the Army. Air Force combat control teams are normally the first elements dropped on each drop zone. The combat control teams locate, identify, and mark the drop and landing zones; establish and operate terminal navigation aids; and establish communications with the troop carrier aircraft to assist in guiding aircraft serials to the proper drop or landing zone. Army assault teams are delivered with the combat control teams. The Army assault teams provide security for the combat control teams while the latter perform their missions. Since no specific mission profile was submitted, this analysis is based on information derived from current doctrinal FMs and various assumptions as to the mission constraints that would apply. The actual composition of the combat control teams and Army assault teams is not currently available from available documentation. Therefore, a mission constraint table is not included for this mission profile. Specific mission constraints are discussed in general terms as they apply to the entire operation. It is assumed that participating aircraft such as combat control aircraft, troop carrier aircraft, and airlift and resupply aircraft will have Class 1 or 2 terminals thus requiring the Class 3 terminal to have a JTIDS interoperability capability. Combat control teams and Army assault teams will be operating in close proximity to enemy forces thus the terrain

use category would be Category 1 and the threat proximity Zone would be F. Personnel of the combat control teams and Army assault teams will be operating primarily in a dismounted role and will be able to handle only limited mission actions while on the move. Both voice and data communications will be used but it is expected that the bulk of the transmission will be by data. Position location accuracy should be below 30 meters and navigational aid is a necessity. Graphics display for the terminals employed by the combat control and assault teams is desirable. There are no system interfaces for any of the teams employed in this mission. It is expected that the teams will also require communications with their higher headquarters which may be located with friendly forces or in an airborne CP. Airborne operations are the normal mission of the Airborne Division and it is assumed that the Army assault teams employed with the combat control teams will come from Airborne Division resources.

1.2.12 Land Combat/Marine Integrated Fire and Air Support System (MIFASS)

MIFASS is a command and control system designed to optimize the utilization of fire and air support assets within a Marine force. The information provided from the functions of fire support and close air support lend much to the decisions that are made in land combat operations. Such information, along with other intelligence data that can be derived therefrom, provide excellent information necessary for the decision making process. Therefore, the prime users of the MIFASS system, are also prime sources for providing the commander and his staff with vital information for the conduct of the land battle. The mission constraints as identified in paragraph 1.2.3 for participants operating in a MIFASS environment are equally applicable to land combat operations.

1.2.13 Ship-to-Shore/Amphibious Assault/Warfare

This paragraph describes the various mission constraints that are applicable to participants engaged in ship-to-shore operations involved in an amphibious assault. During an amphibious assault, ship-to-shore movement is characterized by numerous small craft which must achieve precise positioning with precise timing to deliver their cargo to the correct point on the beach without interfering with other craft and without running afoul of the obstacles off the beach. One of the most important tasks in an amphibious assault is the establishment and operation of facilities to handle the flow of personnel and material over assault beaches. Supplies and equipment for the landing force must continue to flow over the beaches. This over-the-beach movement is an integral part of the ship-to-shore movement. The ship-to-shore operations begin when the Assault Task Force (ATF) has reached its launch area which is generally located about 30-50 miles off shore. The supporting carrier group stands off from the Amphibious Force launch area about 75-150 miles. The ship-to-shore operations will continue during the entire assault while landing forces are being landed and deployed on the beach. As the land force continues to move inland, ship-to-shore operations to provide resupply, gunfire support, and air support will continue. As the land force begins to become more and more self-sufficient, a decrease in ship-to-shore movement will take place. MIFASS is employed aboard ship to assist in the planning functions prior to the assault and also to assist in coordination of fire support and close air support as landing forces are deployed and establish a beachhead.

As the landing force gets established inland, the MIFASS is employed with the Marine Amphibious Force as discussed in paragraph 1.2.3. Because of the distances involved in wide dispersement of ships and landing craft, the threat proximity zones used for land deployment become somewhat meaningless. The FEBA here is assumed to be an imaginary line along the beach area. The deployment in threat proximity zones are based on this assumption with participants placed in relative position to one another. The terrain use factor here really has very little bearing except from the standpoint of proximity to the enemy and this is the only basis used for this factor. For this mission profile, the information provided by Section 4 of NELC Technical Note TN 3199, entitled "Amphibious Operational Situation (U)" and Appendix F, Joint Tactical Information Distribution System Phase II Advanced Development Evaluation (U), Task I Report were used as a basis for determination of probable deployment and composition of a typical Amphibious Assault force operating in a ship-to-shore environment. Table 1.2.13-1 depicts the probable participants operating in such an operation and the mission constraints that are considered applicable to each participant. Where specific ships or landing craft are designated, the participant is assumed to be the ship command element or the boat team commander. In other cases, the particular user facility is indicated. It is assumed that all helicopter and fixed wing assets will have Class 1 or Class 2 terminals. Table 1.2.13-2 depicts the composition of the Amphibious Task Force that is considered in this mission profile analysis.

Table 1.2.13-1 Ship-to-Shore/Amphibious Assault/Warfare

Participant/Facility	Quantity	Terrain Use			Threat Proximity Zone						Mobility					Voice/Data	System Interfaces	Position Location/Navigation		JTIDS Interop	Graphic Display
											Vehicle Utilization			Freq. of Movement	Operations on Move						
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S					Pos.	Nav.		
Amphibious Force:																		+			
CATF	1		X					X			Ship				A	VD		+	Y	Y	Y
CLF	1		X			X	X	X			[illegible]				E	VD	[illegible]	+	Y	Y	Y
ICC	1		X					X			Ship				A	VD		+	Y	Y	Y
LHA	2		X					X			Ship				A	VD		+	Y	Y	Y
LPH	2		X					X			Ship				A	VD		+	Y	Y	Y
LPD	4		X					X			Ship				A	VD		+	Y	Y	Y
LSD	4		X			X	X	X			Ship				A	VD		+	Y	Y	Y
LKA	2		X					X			Ship				A	VD		+	Y	Y	Y
LST	5		X			X	X	X			Ship				A	VD		+	Y	Y	Y
DD	3		X					X	X		Ship				A	VD	[illegible]	+	Y	Y	Y
FFG	6		X					X	X		Ship				A	VD		+	Y	Y	Y
AALC	28	X	X			X	X				Boat				A	VD		+	Y	Y	Y
Advance Group																		+			
SSN	2		X			X					Ship				A	VD		+	Y	Y	Y
UDT Team	1	X	X			X							No vehicle [illegible]		B	VD		+	Y	Y	Y
Covert SF Team	1	X			X										E	VD		+	Y	Y	Y
Elint/Photo A/C	1	X	X		X	X					A/C				A	VD		+	Y	Y	Y
MSH	1		X			X					Ship/[illegible]				A	VD		+	Y	Y	Y
Support Carrier Group:																		+			
SACC	1			X						X	Ship				A	VD	Computer/[illegible]	+	Y	Y	Y
TFCC	1			X						X	Ship				A	VD		+	Y	Y	Y
TSC	1			X						X	Ship				A	VD		+	Y	Y	Y
CV	2			X						X	Ship				A	VD	DMD + [illegible]	+	Y	Y	Y
CG/CGN	6			X						X	Ship				A	VD	[illegible]	+	Y	Y	Y
DD	3			X						X	Ship				A	VD	DMD + [illegible]	+	Y	Y	Y

Table 1.2.13-1 Ship-to-Shore/Amphibious Assault/Warfare (Cont'd)

Participant/Facility	Quantity	Terrain Use			Threat Proximity Zone						Mobility: Vehicle Utilization			Mobility: Freq. of Movement	Mobility: Operations on Move	Voice/ Data	System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphic Display
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. X	Cat. U	Cat. S					Pos.	Nav.		
DDG	3			X						X	Ship				A	VD		+	Y	Y	Y
SSN	2			X						X	Ship				A	VD		+	Y	Y	Y
Mobile Logistics Support Force:																					
AOs	3			X						X	Ship				A	VD		+	Y	Y	Y
CG	1			X						X	Ship				A	VD		+	Y	Y	Y
DE	2			X						X	Ship				A	VD		+	Y	Y	Y
Landing Force:																		+			
MAB	1	X	X			X	X	X	X		Ship/Shore				B	VD	Computer/[illegible]	+	Y	Y	Y
MAG	1	X	X			X	X	X	X		Ship/Shore				C	VD	Computer/[illegible]	+	Y	Y	Y

Table 1.2.13-1 (Cont'd)

NOTES:

1. The terrain use factors here has little importance except from the standpoint of visual observation by the enemy.

2. In many cases, participants are shown in various threat proximity zones because they are constantly on the move and cross from one zone to another in their approach to the beach and return.

Table 1.2.13-2 Amphibious Task Force

Amphibious Force	Support Carrier Group
1 LCC (CATF & CLF embarked)	2 CV** TFCC and TSC Flag embarked
2 LHA (2 AALC* each)	6 CG/CGN
2 LPH	3 DD
4 LPD (each with 4 AALC)	3 DDG
4 LSD (each with 2 AALC)	2 SSN (Operating as a patrol group)
2 LKA	
5 LST	**Mobile Logistics Support Force**
3 DD	3 AOx
6 FFG	1 CG
Advance Group	2 DE
2 SSN	
1 UDT team	**Landing Force**
1 Covert Special Forces Team	1 MAB (12,000 troops)
1 Elint/Photo aircraft	1 MAG (arrives when beachhead secured)
1 MSH (LPH with 15 MCM helicopters)	

* The AALC is a new development amphibious assault landing craft with high-speed and large capacity of air-cushion design.

** Air Force tactical air support units may replace 1 CV.

1.2.14 Ship-to-Shore/Mine Countermeasures (MCM)/Beacon-Buoy

This paragraph describes the various mission constraints that are applicable to participants involved in mine countermeasures missions. Because of the classified nature of the information, the discussion of this mission profile is contained in a separate classified supplement. The discussion in the classified supplement will follow the identical paragraph numbering as if it had appeared here.

1.2.15 Air Reconnaissance/Surveillance/RPV/Drone Control and Guidance

This paragraph describes the various mission constraints that are applicable to participants operating in the control and guidance of RPV/Drone. Because of the classified nature of the information, the discussion of this mission profile is contained in a separate classified supplement. The discussion in the classified supplement will follow the identical paragraph numbering as if it has appeared here.

1.2.16 Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination

This paragraph describes the various mission constraints that are applicable to participants that are involved in the gathering and dissemination of intelligence derived from air reconnaissance and surveillance. Aerial surveillance and reconnaissance missions are performed in support of Army units by organic Army aviation units and tactical air support from other services. Effective reconnaissance provides necessary information about the enemy, terrain, and weather. Army aerial collection capability is provided by aviators, aerial observers, sensors, and sensor equipment operators using organic airplanes and helicopter platforms. Present collection capabilities include visual observation, photography, radar and infrared imagery, and electronic surveillance. Organic rotary-wing aircraft give the division and corps a visual observation capability, however, none of these aircraft, except those of the cavalry squadrons has the primary mission of visual air reconnaissance. However, the division and corps take advantage of the information-gathering capability of Army aircraft provided it does not interfere with their primary missions of command, control, and combat support. Based on the above, only those units having a specific mission of air reconnaissance are included in the analysis given in Table 1.2.16-1. To give some idea of the volume of aircraft available in the division and the corps, the following organic and attached unit capabilities are given:

Unit	Quantity Helicopters	Fixed Wing
Division:		
BDE Aviation Section	4	
DIVARTY Aviation Section	14	
DIV Aviation Bn (Infantry Div)	37	
DIV Aviation Co. (Armored and Mechanized Divs)	10	
ACS Air Cavalry Troop	*27	
Corps:		
ACR Air Cavalry Troop	*27	
ACR Hq. and Hq. Troop	10	
ACS Hq. and Hq. Troop	** 4	
Aerial Exploitation Bn		30
***Attack Helicopter Bn	108	
***Assault Helicopter Bn	75	

* 10 of these helicopters are specifically designated for air reconnaissance and belong to the Aeroscout Platoon.

** There are 3 ACSs per ACR making a total of 12 helicopters in the three ACSs.

*** The corps may have these units assigned or attached as required.

Intercommunication between air controlling elements at all echelons as well as the attached Air Force liaison and control facilities is necessary. It is also necessary that these facilities have the capability of intercommunicating with the aircraft that is performing the air reconnaissance mission. Preplanned requests for air reconnaissance are handled in the same manner as for close air support preplanned requests as described in paragraph 1.2.7. Immediate requests for air reconnaissance to be provided by tactical air is also handled as described in paragraph 1.2.7 for immediate requests for close air support. For immediate requests for Army aviation, if the request is within the capability of Army aviation,

if aircraft are available, and if the mission can be accomplished within the time desired, the request is passed through the ground force airspace control elements at the various echelons to the Army aviation unit providing support. In this mission profile, the participants shown are the Air Force and Army users at the various echelons for a corps with four divisions and each brigade with five battalions. The organic units that have specific air reconnaissance missions are also shown. Table 1.2.16-1 depicts the various mission constraints that are applicable to the particular users. When dealing with air reconnaissance operations in a Marine unit, the MIFASS would be employed as it is for fire support and close air support. Paragraph 1.2.3 provides a discussion of the mission constraints applicable to users operating in a MIFASS environment.

Table 1.2.16-1 Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination

Participant/Facility	Quantity	Terrain Use			Threat Proximity Zone						Mobility					Voice/Data	System Interfaces	Position Location/Navigation		JTIDS Interop	Graphic Display
											Vehicle Utilization			Freq. of Movement	Operations on Move						
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S					Pos.	Nav.		
Corps Elements:																		+			
TACC (AF)	1			X						X	TRUCK MTD SHELTER				C	VD		+	Y	Y	Y
TUOC (AF)	1			X						X			TRUCK		C	VD		+	Y	Y	Y
DASC (AF)	1			X						X	TRUCK MTD SHELTER				C	VD		+	Y	Y	Y
CTOC/TASE (Army)	1			X						X	TRUCK MTD SHELTER				B	VD	Computer/TDS	+	Y	Y	N
CTOC/EWIOC (Army)	1			X						X	TRUCK MTD SHELTER				B	VD	Computer / TDS	+	Y	Y	N
CEWI Group (Army)	1			X						X	TRUCK MTD SHELTER				B	VD	Computer/Graphic Computer /TCAS	+	Y	Y	N
AE BN (Army)	1			X						X		TRUCK			B	VD		+	Y	Y	Y
AE BN A/C (Army)	30	X			X	X					FIXED WING A/C				A	VD		+	Y	Y	Y
Weather Element (AF)	1			X						X		TRUCK			B	VD		+	Y	Y	Y
ACR Air Cav Troop (Army)	1	X			X							TRUCK			B	VD		+	Y	Y	Y
AEROSCOUT PLT A/C (Army)	10	X			X	X					HCPTR				A	VD		+	Y	Y	Y

Table 1.2.16-1 Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination (Cont'd)

Participant/Facility	Quantity	Terrain Use Cat. 1	Terrain Use Cat. 2	Terrain Use Cat. 3	Threat Proximity Zone F	A	B	C	D	E	Mobility: Vehicle Utilization Cat. X	Cat. U	Cat. S	Freq. of Movement	Operations on Move	Voice/Data	System Interfaces	Position Location/Navigation Pos.	Nav.	JTIDS Interop	Graphic Display
Division Elements:																					
DTOC/TASE (Army)	4			X					X		Truck Mtd Shelter				B	VD	Computer/TOS	+	Y	Y	N
DTOC/EWIOC (Army)	4			X					X		Truck Mtd Shelter				B	VD	Computer/TOS	+	Y	Y	N
Weather Element (AF)	4			X					X			Truck			B	VD		+	Y	Y	Y
TACP (Div) (AF)	4			X					X		Truck Mtd Shelter				C	VD		+	Y	Y	Y
CEWI Bn (Army)	4			X					X		Truck Mtd Shelter				B	VD	Computer/TOAS	+	Y	Y	N
ACS Air Cav Troop (Army)	4	X				X						Truck			B	VD		+	Y	Y	Y
Aeroscout Plt A/C (Army)	40	X			X	X					HCPTR				A	VD		+	Y	Y	Y
FSCC (BDE)(S3 Air) (Army)	12			X				X			Truck Mtd Shelter				B	VD	TCS/TOS	+	Y	Y	N
TACP (BDE) (AF)	12			X				X			Truck Mtd Shelter				C	VD		+	Y	Y	Y
AFAC (BDE) (AF)	12	X				X					A/C				A	VD		−	Y	Y	Y
FSCC (BN)(S3) (Army)	60		X				X					Carrier, CP			B	VD	TCS/TOS	+	Y	Y	N
TACP (BN) (AF)	60		X				X					Truck			C	VD		+	Y	Y	Y
GFAC (BN) (AF)	60	X				X							Truck		C	VD		−	Y	Y	Y
CO COMDR (Army)	180	X				X							Truck		C	VD		+	Y	Y	Y

Table 1.2.16-1 (Cont'd)

Notes:

1. The AE Battalion aircraft are shown in terrain use category 1 but it must be remembered that these are fixed wing aircraft, which make no use of terrain cover and concealment and being airborne are visible to the enemy.
2. Aircraft are shown in threat proximity Zones F and A because some times they will be operating along the FEBA while other times they will be overflying enemy held territory.
3. The ACR Air Cavalry Troop is shown in terrain use category 1 and threat proximity zone F based on its normal mission of operating as a covering force. In other deployments, these factors would change.
4. It is assumed that AF personnel at the various echelons will possess the required vehicles to be as mobile as the echelon headquarters which they are supporting. It is further assumed, that at echelons where shelters are employed, AF personnel will be housed in shelters so as to be collocated with ground force counterparts.
5. Since navigational aid requirements exist for the AF users, it is assumed that the Army counterparts will also have the same requirement.
6. JTIDS interoperability would be required in order to intercommunicate with tactical air mission aircraft having class 1 or class 2 terminals.
7. For those users where system interfaces are not indicated, a graphic display may be desirable.

1.3 MISSION CONSTRAINTS ON BAND OF PERFORMANCE SUMMARY

This paragraph provides a summarization of the analysis and tabular presentation information contained in paragraph 1.2. Because of lack of detailed information, some of the mission profiles do not contain tabular information detailing specific factors but discuss the factors in general terms. Not all of the mission profiles as presented in paragraph 1.2, are based on identical echelon structure because of differences in service orientation and mission applicability. Therefore, to insure a logical summarization of the data, the mission profiles have been segregated according to the service to which they are most closely related. The segregation for summarization is as follows:

Service Orientation	Mission Profile
Army/Air Force	Fire Support/Army Tactical Fire Support (TACFIRE)
	Air Defense/Short Range Air Defense (SHORAD)
	Air Defense/Long Range Air Defense (LORAD)/PATRIOT
	Close Air Support/Air Request Net (TACP-DASC)
	Close Air Support/Helicopter Nap of the Earth (NOE)
	Land Combat/Tactical Operations System (TOS)
	Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination
	Land Combat/"Bare Base" Combat Control Teams (CCT)
Marine	Fire Support/Marine Integrated Fire and Air Support Systems (MIFASS)
	Close Air Support/Marine Integrated Fire and Air Support System (MIFASS)
	Land Combat/Marine Integrated Fire and Air Support System (MIFASS)

Navy	Fire Support/Naval Gunfire Support
	Air Defense/Missile Guidance and Control
	Ship-to-Shore/Amphibious Assault/Warfare
	Ship-to-Shore/Mine Countermeasures (MCM)/ Beacon-Buoy
	Air Reconnaissance/Surveillance/RPV/Drone Control and Guidance

Although the mission profile "Close Air Support/Air Request Net (TACP-DASC)" is an Air Force mission and the mission profile "Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination" could involve the Air Force, both are consolidated with the Army profiles because the Air Force participants are collocated with and in support of the Army tactical echelons.

The Naval Gunfire support, although structured to operate at the various Army division tactical echelons, only pertains to those organizations where the situation dictates and does not apply to all divisions of the Army. Therefore, it has been considered as not being Army oriented.

The CCT operations include both Air Force and Army participants.

1.3.1 Summary Tables.

Where possible, tables are provided summarizing all the data of the applicable mission profiles within the specific service orientation. Each mission profile mission constraint table in paragraph 1.2 is analyzed and adjusted where necessary to take into consideration differences in echelon structure. After necessary adjustments are made, all data is totaled and entered on the appropriate summary table. After all profile totals are entered, the figures are subtotaled. From the subtotal is subtracted any duplications that exist within the various profiles to arrive at an adjusted total. Duplications are caused by identical participants appearing in more than one profile. Duplications are eliminated based on the assumption that one terminal at a given location or used by a given participant can provide entry into several JTIDS nets.

Each mission constraint category indicates the number of applicable participants. There are five mission constraint columns that contain two figures separated by a slash. The following information explains the relationship of these two figures in each column:

- "System Interfaces" column - the first number indicates the number of participants that have a potential digital interface requirement while the second number indicates the number of participants that do not have such a requirement. For example, a number such as 360/5 indicates that there are 360 participants with potential interface requirements and 5 participants that do not have the requirement.

- "Pos" column - the first number indicates those participants with an accuracy requirement greater than 30 meters while the second number indicates those participants with an accuracy requirement of 30 meters or less. For example, a number such as 213/152 indicates that 213 participants have an accuracy requirement greater than 30 meters and 152 participants have an accuracy requirement of 30 meters or less.
- "Nav" column - the first number indicates the number of participants that have navigational requirements while the second number indicates those who do not. For example, a figure of 333/32 indicates that 333 participants have navigational requirements while 32 do not.
- "JTIDS Interop" column - the first figure indicates those participants that have a requirement to Interop with Class 1 and Class 2 JTIDS terminals while the second number indicates those participants that do not have the Interop requirement. For example, a figure of 10/355 indicates that 10 participants have Interop requirements while 355 participants do not.
- "Graphic Display" column - the first number indicates those participants for which a graphic display may be desirable while the second number indicates those participants that have no graphic display requirement. For example, a figure of 15/350 indicates that for 15 participants a graphic display capability may be desirable while for 350 participants the display capability is not needed.

1.3.2 Army/Air Force Orientation Summary

In order for all the data included in all the Army and Air Force mission profiles to be summarized, certain adjustments must be made to some of the tabular information. The required adjustments are as follows:

- Table 1.2.1-1 - This tabular data must be adjusted to provide for a Corps with 4 Divisions; each Division having 3 Brigades; and each Brigade having 5 Battalions. Also, with the addition of the Corps to the tabular data, the FSE (CTOC) and the Lance Battalion with 3 batteries must be added. Since current concepts pertaining to the Artillery Group and its composition are not yet firm, no consideration has been given here to the Group.
- Table 1.2.4-1 - This tabular data must be adjusted to provide for a Corps with 4 Divisions; each Division having 3 Brigades; and each Brigade having 5 Battalions.
- Table 1.2.5-1 and 1.2.5-2 - Only the information pertaining to the PATRIOT organization is considered. The participant figures are adjusted to take into consideration 4 Divisions instead of 3.

With the above adjustments, all tabular data can be summarized on a common basis with like Army echelon structure for all Army oriented mission profiles. Because of the lack of details pertaining to specific participants (composition of the CCT) in the Land Combat/"Bare Base" Combat Control Teams (CCT) mission profile, the applicable mission constraints were discussed in paragraph 1.2.11 in general terms. Therefore, there is no tabular information to be summarized here. Table 1.3.2-1 provides a summary of the Army/Air Force mission profiles based on a Corps with 4 Divisions consisting of 3 brigades with 5 maneuver battalions each.

Table 1.3.2-1 Army/Air Force Orientation Summary

Mission Profile	Quantity	Terrain Use			Threat Proximity Zone						Mobility						System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphics Display
											Vehicle Utilization			Operations On Move							
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S	A	B	C		Pos.	Nav.		
Fire Support/ TACFIRE	365	152	136	77		152	96	72	40	5	185	60	120	32	151	182	365 / 0	213 / 152	333 / 32	0 / 365	0 / 365
Air Defense/SHORAD	942	324	412	206	24	300	336	100	16	166	174	348	420		5	937	5 / 937	942 / 0	0 / 942	0 / 942	937 / 5
Air Defense/LORAD	167			167					82	85	167				5	162	162 / 5	167 / 0	0 / 167	167 / 0	5 / 162
Close Air Support/ Air Request Net	408	252	120	36		252	120	24	8	4	47	120	241	12	77	319	77 / 331	336 / 72	408 / 0	408 / 0	331 / 77
Close Air Support/ NOE	473	394	60	19	205	192	60	12	4		226	67	180	209	84	180	77 / 396	473 / 0	473 / 0	0 / 473	396 / 77
Land Combat/TOS	140	7	65	68	7		65	17	40	11	49	91			140		139 / 1	140 / 0	0 / 140	0 / 140	0 / 140
Air Recon/Intel Gathering & Dissemination	509	337	120	52	41	296	120	24	20	8	137	131	241	92	98	319	87 / 422	437 / 72	509 / 0	509 / 0	422 / 87
SUBTOTALS	3004	1466	913	625	277	1192	797	249	210	279	985	817	1202	345	560	2099	912 / 2092	2708 / 296	1723 / 1281	1084 / 1920	2091 / 913
Less: Duplications	681	437	180	64	1	436	180	36	21	7	71	185	425	12	164	505	160 / 521	609 / 72	672 / 9	596 / 75	521 / 160
ADJUSTED TOTALS	2323	1029	733	561	276	756	617	213	189	272	914	632	777	333	396	1594	752 / 1571	2099 / 224	1051 / 1272	488 / 1835	1570 / 753

Table 1.3.2-2 provides a summary projection for the 1980-1990 timeframe. The adjusted totals from Table 1.3.2-1 are used as a basis and multiplied by a factor of 6 to reflect the total requirements for 6 Army Corps with 24 Army Divisions anticipated for the Army during the 1980-1990 timeframe.

1.3.3 Marine Orientation Summary

Since the mission constraint Table 1.2.3-1 is applicable to Fire Support, Close Air Support, and Land Combat Operations for the Marines, it is only necessary to summarize the data in that table. This summary of data is then projected for 3 MAFs which is the expected total Marine Corps for the 1980-1990 time frame. Table 1.3.3-1 provides the details of this summarization. Since the quantity of NGF ships can vary, for this summary, the total quantity is considered to be 6.

1.3.4 Navy Orientation Summary.

Because of lack of details pertaining to specific participants in some of the Navy oriented mission profiles only two profiles, Fire Support/Naval Gunfire Support and Ship-to-Shore/Amphibious Assault/Warfare have been tabulated in paragraph 1.2. For the other three mission profiles, mission constraints were only discussed in general terms in paragraph 1.2. Table 1.3.4-1 provides a summary of the mission constraint factors as derived from Tables 1.2.2-1 and 1.2.13-1 of paragraph 1.2 projected for three ANGLICOs and two amphibious assault forces of the size indicated. The Navy has indicated that they anticipate only one ANGLICO would be in operation at any one time. However, it is expected that the equivalent of three ANGLICOs will exist in total. The Navy has also indicated that they expect two amphibious assault forces of the size indicated may be operating in line-of-sight of each other. In NGF support, the number of cruisers and destroyers used to provide Naval Gunfire

Table 1.3.2-2 Army/Air Force Orientation Summary Projection for 1980 - 1990 Time Frame

Mission Profile	Quantity	Terrain Use			Threat Proximity Zone						Mobility: Vehicle Utilization			Mobility: Operations On Move			System Interfaces	Position Location/Navigation		JTIDS Interop	Graphics Display
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S	A	B	C		Pos.	Nav.		
[redacted] TOTALS	13938	6174	4398	3366	1656	4536	3702	1278	1134	1637	5484	3792	4662	1998	2276	9564	4512 / 9426	12594 / 1344	6306 / 7632	2928 / 11010	9420 / 4518

Table 1.3.3-1 Marine Orientation Summary

Mission Profile	Quantity	Terrain Use			Threat Proximity Zone						Mobility						System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphics Display
											Vehicle Utilization			Operations On Move							
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat A	Cat. U	Cat. S	A	B	C		Pos.	Neg.		
MIFASS	435	315	90	30		315	63	36	6	15		15	420	42		393	435 / 0	147 / 288	0 / 435	435 / 0	0 / 435
SUBTOTALS	435	315	90	30		315	63	36	6	15		15	420	42		393	435 / 0	147 / 288	0 / 435	435 / 0	0 / 435
Less Duplications																					
ADJUSTED TOTALS	435	315	90	30		315	63	36	6	15		15	420	42		393	435 / 0	147 / 288	0 / 435	435 / 0	0 / 435

Table 1.3.4-1 Navy Orientation Summary

Mission Profile	Quantity	Terrain Use			Threat Proximity Zone						Mobility						System Interfaces	Position Location/ Navigation		JTIDS Interop	Graphics Display
											Vehicle Utilization			Operations On Move							
		Cat. 1	Cat. 2	Cat. 3	F	A	B	C	D	E	Cat. A	Cat. U	Cat. S	A	B	C		Pos.	Neg.		
NGF	204	45	117	42		45	90	27	9	33	30	93	81	30	174		0 / 204	204 / 0	30 / 174	159 / 45	204 / 0
Amphibious Assault	184	66	68	50	4	88		42		50	180		4	174	10		36 / 148	184 / 0	184 / 0	184 / 0	184 / 0
SUBTOTALS	388	111	185	92	4	133	90	69	9	83	210	93	85	204	184		36 / 352	388 / 0	214 / 174	343 / 45	388 / 0
Less Duplications																					
ADJUSTED TOTALS	388	111	185	92	4	133	90	69	9	83	210	93	85	204	184		36 / 352	388 / 0	214 / 174	343 / 45	388 / 0

Support will vary with the situation. In order to provide for a summarization here, it is assumed that there are 4 cruisers and 6 destroyers providing the support to the divisional size unit.

2.0 CANDIDATE NETWORK CONCEPTS

The following paragraphs describe the representative applications of the Class 3 terminal selected for detailed network analysis. An attempt has been made to select both widely representative applications and also a variety of approaches. Applications have also been selected based on their degree of difficulty. Some applications with more obvious solutions are to be treated in less detail.

2.1 SYSTEM APPLICATIONS

The first approach to be analyzed for JTIDS application is to examine specific systems that require high levels of digital data communications over a significant area of the battlefield. In this category, some systems are selected for detailed analysis and others, because of their less complex nature, will be included to a lesser extent. Detailed analysis will be performed on the TACFIRE and MIFASS systems. Both are systems involving many users at all echelons and covering a large area on the battlefield. The TOS system will be covered by comparison to TACFIRE and MIFASS because much of the analysis for TACFIRE and MIFASS will also be applicable to TOS. In addition, the RPV functions will be covered for both close in and over the horizon applications. The RPV application is considered straight forward and will require less complex analysis than systems such as TACFIRE and MIFASS.

2.2 MISSION APPLICATIONS

The second approach to defining JTIDS nets for analysis is to examine specific missions that may cut across system and even service boundaries. Primary analysis will be conducted on:

a. Air Defense Missions (to include LORAD and SHORAD).

b. Close Air Support Missions (to include Tac Air and Helicopter NOE).

c. Ship to Shore Movement - Landing Craft Control.

d. Forward Terminal Operations (to include CCT and Army Equivalent).

Mine/Counter Mine operations will be discussed as well, though only to the level of detail warranted by its less complex requirements.

2.3 FUNCTIONAL APPLICATIONS

A third approach used in defining potential JTIDS nets is to examine possible services that can be rendered on a geographic basis transcending system, service and mission boundaries. The following potential nets are subjects for examination under this approach:

2.3.1. Forward Airspace Management Net

Such a net could be used by cooperating aircraft of all services and by ground facilities involved in the use of or control of airspace forward of the division rear boundary. Flight following could be provided by an air traffic center. Artillery advisories could be placed in the net by fire control agencies. Air defense

units could supply information on restricted zones. Locations of friendly units could be established for aircraft needing such information. Hostile track information could be made available and emergency airspace control measures could be imposed by means of such a net. In general, it would provide a pilot all the information he needs from various sources to operate in the airspace forward of the division rear boundary.

2.3.2. <u>Battlefield Intelligence Collection/Dissemination Net</u>

This net would have as participants not only collectors of intelligence (such as sensors) and users of intelligence (such as maneuver units), but also the intelligence analysts as well. Careful assignment of time slots would serve to provide an initial differentiation of types of intelligence (raw versus processed, etc.) and would allow participants to receive only those types in which they are interested. Message type indicators could produce another level of screening and geographic area designators could provide a final means of a user ensuring that he received what he wanted. This net would serve to make raw intelligence immediately available to those elements who can use it. It would also serve to get the raw intelligence to the analysis facilities where it can be processed and collated with other sources. Finally, it would be a means for dissemination of finished intelligence to all users. If sufficient capacity is available, this net could also serve as an intelligence request net and as a sensor/collector tasking media.

2.3.3. Beachhead/Airhead Operations Net

Beachhead and Airhead operations are characterized by a need for a massive (almost heroic) coordination effort between tactical elements, fire and air support forces, and the logistical elements trying to squeeze vast amounts of men and material through a small piece of real estate in the shortest possible time. JTIDS offers such an operation an unparalleled set of advantages. It can provide large numbers of participants automatic real time status and position reporting, selective retrieval of information, and rapid access communication to any participant. These advantages can go a long way toward reducing the inefficiencies that have limited such operations in the past.

2.4 CORRELATION WITH MISSION PROFILES

Table 2.4-1 shows the relationship of the SPO identified mission profiles with the nets described above.

2.5 PRIORITY OF ANALYSIS

In order to ensure that appropriate areas are covered within the resources available, the nets to be subjected to analysis must be placed in a priority scheme. Priority one includes selected nets of prime importance from each of the categories described in paragraphs 2.1 through 2.3. These nets are to be analyzed first and in detail.

Table 2.4-1 Mission Profile Relationships to Nets

NET	ASSOCIATED PROFILES	MISSION
System Applications:		
TACFIRE	Army Tactical Fire Support (TACFIRE)	Fire Support Operations
MIFASS	Marine Integrated Fire and Air Support Systems (MIFASS)	Fire Support Operations Close Air Support Opns Land Combat Operations
TOS	Tactical Operations System (TOS)	Land Combat Operations
RPV	RPV/Drone Control & Guidance	Air Reconnaissance/ Surveillance Operations
Mission Applications:		
Air Defense	Short Range Air Defense (SHORAD) Long Range Air Defense (LORAD)/ PATRIOT Missile Guidance & Control	Air Defense Operations Air Defense Operations Air Defense Operations
Close Air Support	Air Request Net (TACP-DASC) Helicopter Nap of the Earth (NOE) MIFASS	Close Air Support Opns Close Air Support Opns Close Air Support Opns
Landing Craft Control	Amphibious Assault/Warfare	Ship-to-Shore Operations
Forward Terminal Operations	"Bare Base" Combat Control Teams (CCT)	Land Combat Operations
Functional Applications:		
Forward Airspace Management	Marine Integrated Fire & Air Support System (MIFASS) Short Range Air Defense (SHORAD) Long Range Air Defense (LORAD)/ PATRIOT Army Tactical Fire Support (TACFIRE) Air Request Net (TACP-DASC) Helicopter Nap of the Earth (NOE) Tactical Operations System (TOS)	Close Air Support Opns Air Defense Operations Air Defense Operations Fire Support Operations Close Air Support Opns Close Air Support Opns Land Combat Operations
Battlefield Intelligence Collection & Dissemination	Intelligence Gathering & Dissemination Tactical Operations System (TOS)	Air Reconnaissance/ Surveillance Operations Land Combat Operations
Beachhead/Airhead Operations Net	Mine Countermeasures (MCM) Beacon-Buoy Naval Gunfire Support	Ship-to-Shore Operations Fire Support Operations

Priority two nets are those which either duplicate or are in a large measure similar to priority one nets or are those that offer little technical difficulty in their application. These nets will be given a less detailed analysis than the nets in priority one. The depth of analysis will depend on the resources available following the completion of priority one analyses. Table 2.5-1 indicates the priority assigned to each of the nets listed earlier.

Table 2.5-1 Net Analysis Priorities

PRIORITY ONE	PRIORITY TWO
SYSTEM APPLICATIONS	
TACFIRE	TOS
MIFASS	RPV
MISSION APPLICATIONS	
AIR DEFENSE	LANDING CRAFT CONTROL
CLOSE AIR SUPPORT	FORWARD TERMINAL OPERATIONS
FUNCTIONAL APPLICATIONS	
FORWARD AIRSPACE MANAGEMENT	BEACHHEAD/AIRHEAD OPERATIONS
BATTLEFIELD INTELLIGENCE COLLECTION AND DISSEMINATION	

3.0 ANALYSIS OF NETWORK CONCEPTS

The following paragraphs discuss the analysis conducted for the representative network applications as described in paragraph 2.0. Each of the applications is evaluated separately based on its applicability to the various participants of appropriate mission profiles.

3.1 FACTORS CONSIDERED

For each analysis, certain factors are considered which have a direct bearing on the network architecture. These factors provide the basis for determining the capacity of the network, whether partitioning is necessary, and the applicability of single/multiple networks.

3.1.1 Geographical Relationships

Each network consists of a set of users who are spread to some degree across the battlefield. For each network analyzed, a representative pattern is depicted showing the geographical relationships of the participants of the network. This information is presented in the form of schematic diagrams showing the typical distances and expected maximum distances between network elements. These schematic diagrams also show the typical information flow paths between the various participants and the relative proximity to threat activities. The boundaries depicted in these schematics are shown as straight lines, however in actuality would not be straight but based on the terrain features that exist in the battlefield operational area.

For those networks that are based on Army echelon structure, a set of schematics provide the basic graphic presentations for a corps with four divisions; each division having 3 brigades consisting of 5 maneuvers battalions each. Figure 3.1.1-1 depicts a typical corps area of operation with only major headquarters approximate locations shown. From this figure, the middle division is selected and depicted in larger scale in figure 3.1.1-2. From figure 3.1.1-2, the bottom brigade is selected and depicted in larger scale in figure 3.1.1-3. These three figures can now be used to graphically display the geographical relationships of participants in Army oriented networks by superimposing the network participants on the basic schematic diagrams. Approximate distances can be derived from the figures by physical measurement of the separation between elements, bearing in mind the adjustments that must be made based on the scales of each figure (the scale of figure 3.1.1-2 is two times the scale of figure 3.1.1-3 while the scale of figure 3.1.1-1 is 2.75 times the scale of figure 3.1.1-2 and 5.5 times the scale of figure 3.1.1-3). These diagrams are based on typical deployment of a corps in a defensive position. When determining distances, measurement is made in a straight line from the center point of one schematic symbol for a particular participant to the center point of another schematic symbol of another participant. For other candidate applications which are based on Marine, Navy, or Air Force orientation, similar schematic diagrams are presented where appropriate.

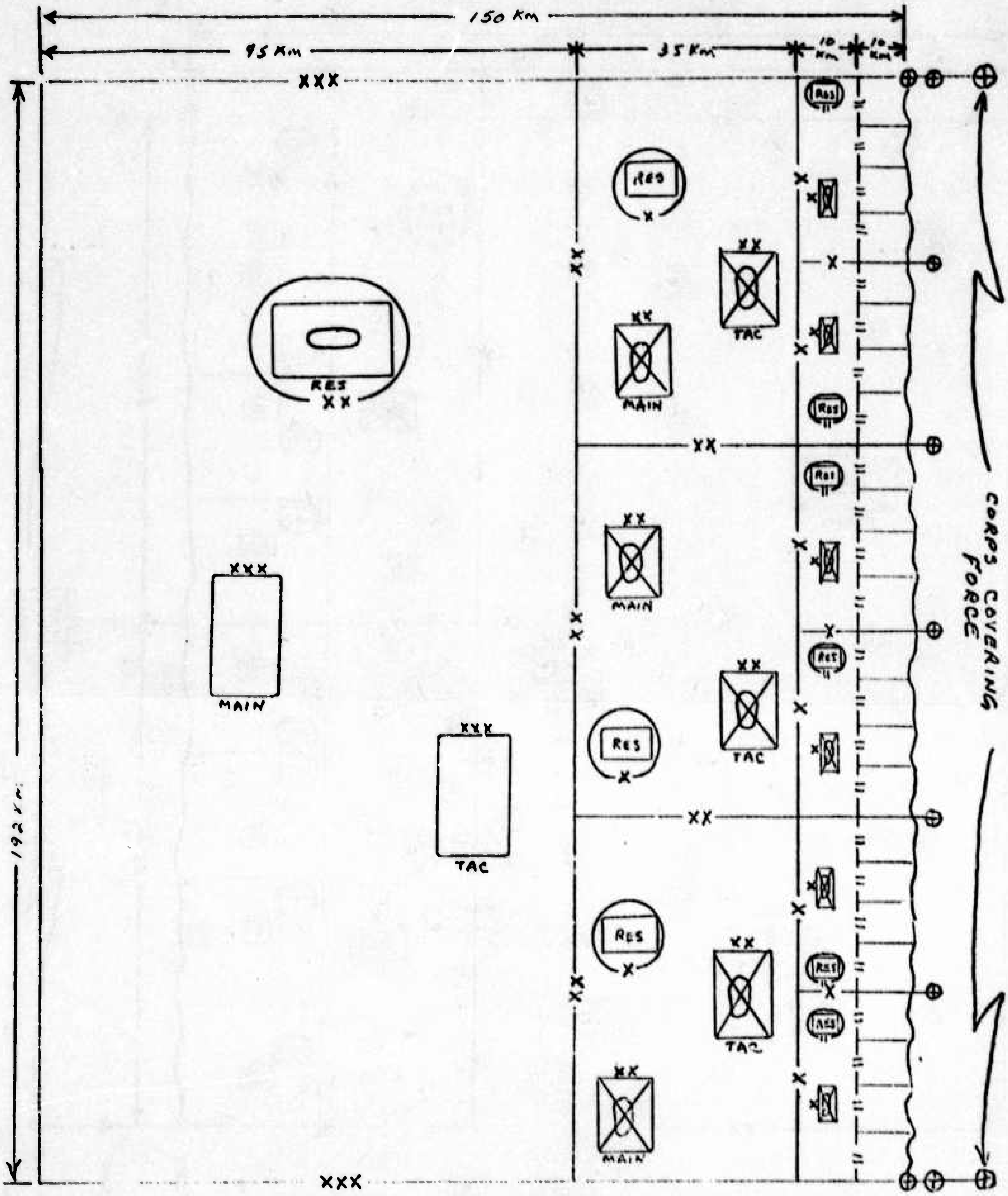

Figure 3.1.1-1 Type Corps Area of Operations

1" = 22 Km

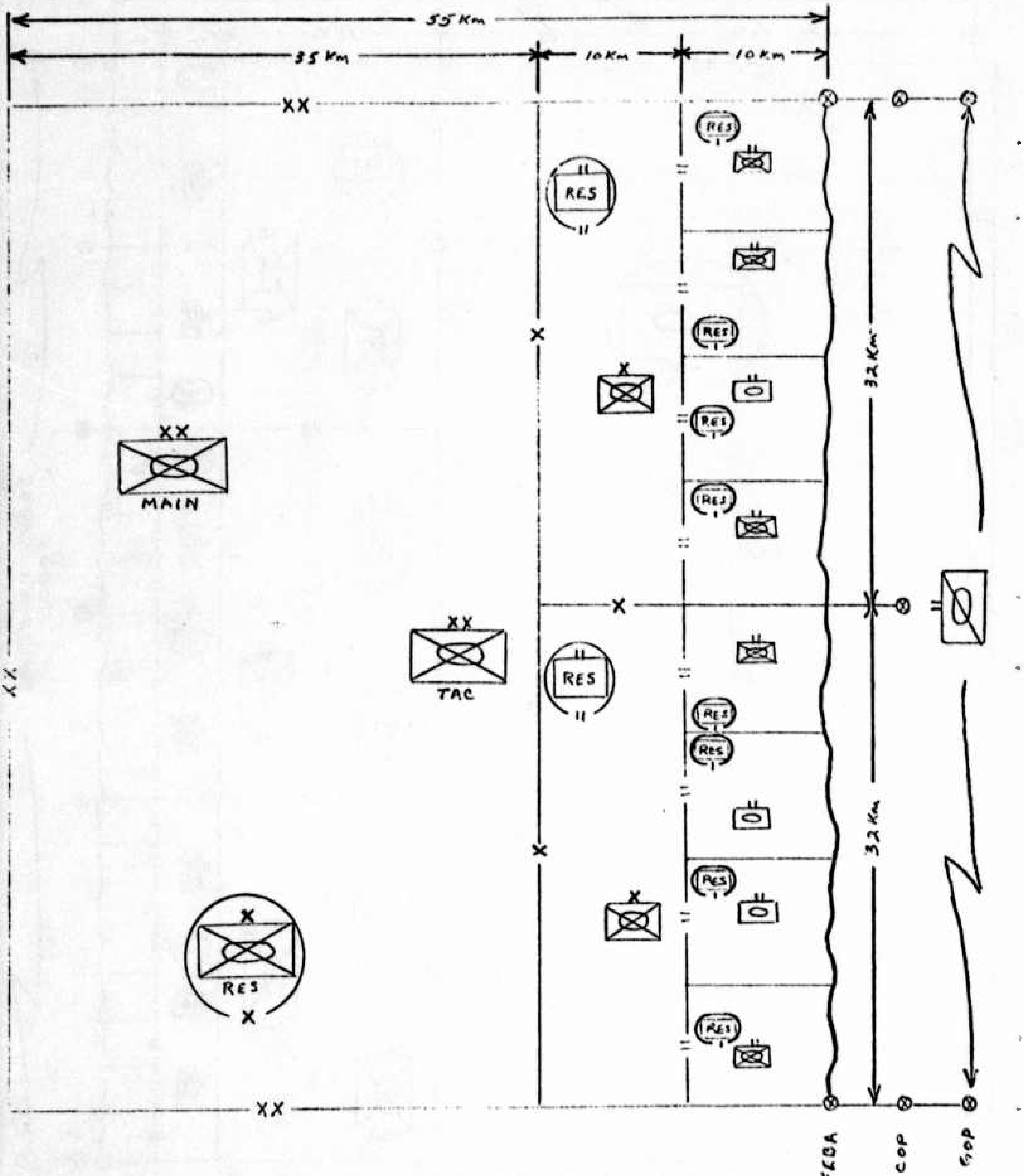

Figure 3.1.1-2 Type Division Area of Operations

1" = 8 Km

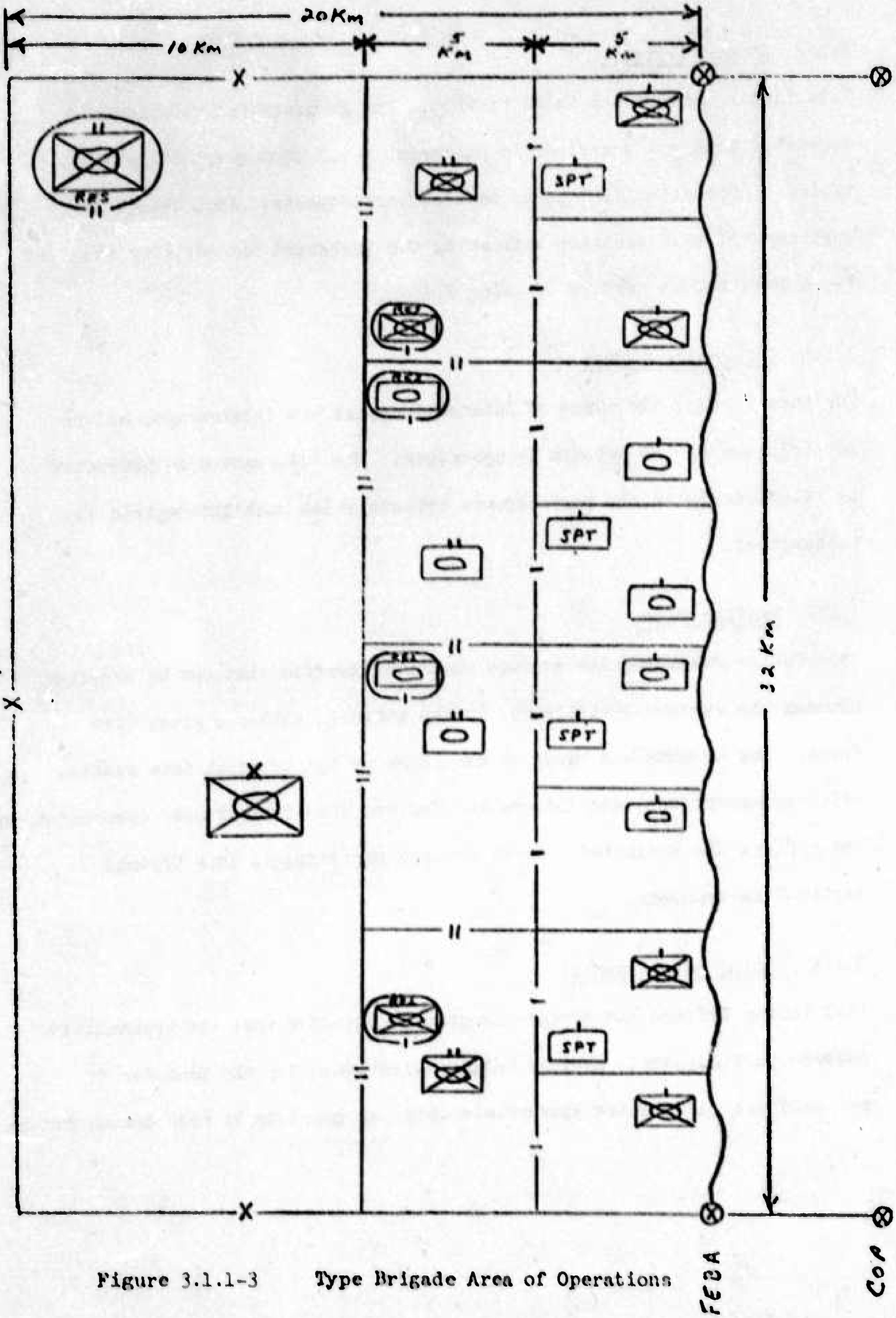

Figure 3.1.1-3 Type Brigade Area of Operations

1" = 4 Km

3.1.2 Connectivity.

This factor defines who talks to whom. The geographical relationship schematic diagrams described in paragraph 3.1.1 show graphically the typical information flow paths between participants. Such detail is supplemented by discussion indicating the increased connectivity that can be derived in the network by using JTIDS.

3.1.3 Information Types.

For this factor, the types of information that are interchanged between participants of the network is described. The information is presented in relationship to the participants between which such information is transmitted.

3.1.4 Traffic Flow.

This factor describes the average amount of traffic that can be expected between the various participants in the network, within a given time frame. The amounts are based on knowledge of the tactical data system, military experience, and information derived from various user documentation and reflect the estimated volumes between participants in a typical tactical environment.

3.1.5 Timing Requirements.

This factor defines the average lengths of messages that are transmitted between participants. Average transmission times for the transfer of messages are given where appropriate data was provided by user documentation.

3.2 APPLICATION OF FACTORS

All of the above factors when taken and analyzed together or in combination provide the basis for further analysis to determine the total capacity that may be expected in the network, whether positioning is necessary to allow for maximum utilization of network time slots, the amount of relays that may be required in order to accomplish complete coverage of all participants in a network, and whether or not a single network will suffice or if multiple networks are necessary to provide the required capacity and coverage.

3.3 ANALYSIS AND GRAPHICAL PRESENTATION

The following paragraphs discuss the various factors for each candidate network and analyzes these factors to arrive at a basis for network architecture. A separate paragraph is presented for each separate candidate application. Supporting schematic diagrams are presented to graphically depict geographical relationships of participants and information flow paths. Amplifying notes are included with the schematic diagrams to provide supplemental information that cannot appear in the figures. The following candidate networks are discussed in paragraphs as indicated:

Candidate Network	Type Application	Paragraph No.
TACFIRE	System	3.3.1
MIFASS	System	3.3.2
Air Defense	Mission	3.3.3
Close Air Support	Misson	3.3.4
Forward Airspace Management	Functional	3.3.5
Battlefield Intelligence Collection and Dissemination	Functional	3.3.6
TOS	System	3.3.7
RPV	System	3.3.8
Landing Craft Control	Mission	3.3.9
Forward Terminal Operations	Mission	3.3.10
Beachhead/Airhead Operations	Functional	3.3.11

3.3.1 TACFIRE

This paragraph discusses the various factors in relationship to the participants operating in a TACFIRE network.

3.3.1.1 Geographical Relationships. Figures 3.3.1.1-1 (Corps area), 3.3.1.1-2 (Center Division Slice) and 3.3.1.1-3 (lower Brigade slice) depict typical deployment of TACFIRE participants and shows the information flow paths by which TACFIRE data is passed back and forth between the participants.

3.3.1.1.1 Identity Codes. To further facilitate identity of the participants, each is assigned a code as follows:

Participants	Code
Corps:	
CTOC (FAS)	CTF
Corps Reserve Division (DivArty)	DA4
Lance Bn	CLB
Lance Battery (Upper)	LB1
Lance Battery (Middle)	LB2
Lance Battery (Lower)	LB3
Division:	
DivArty (Upper Div)	DA1
DivArty (Middle Div)	DA2
DivArty (Lower Div)	DA3

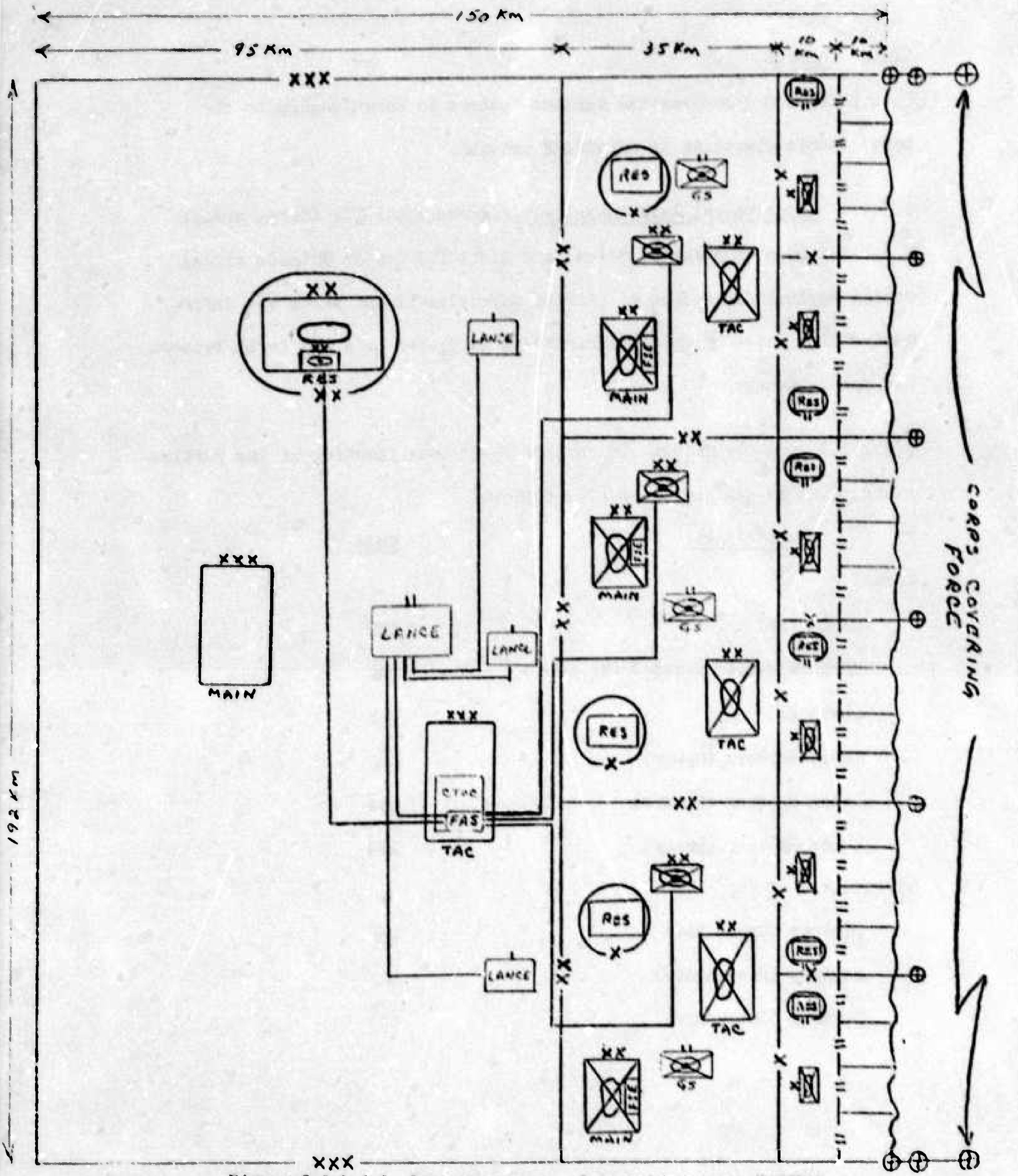

Figure 3.3.1.1-1 Type Corps Area of Operations with TACFIRE Participants and Lines of Information Flow

1" = 22 Km

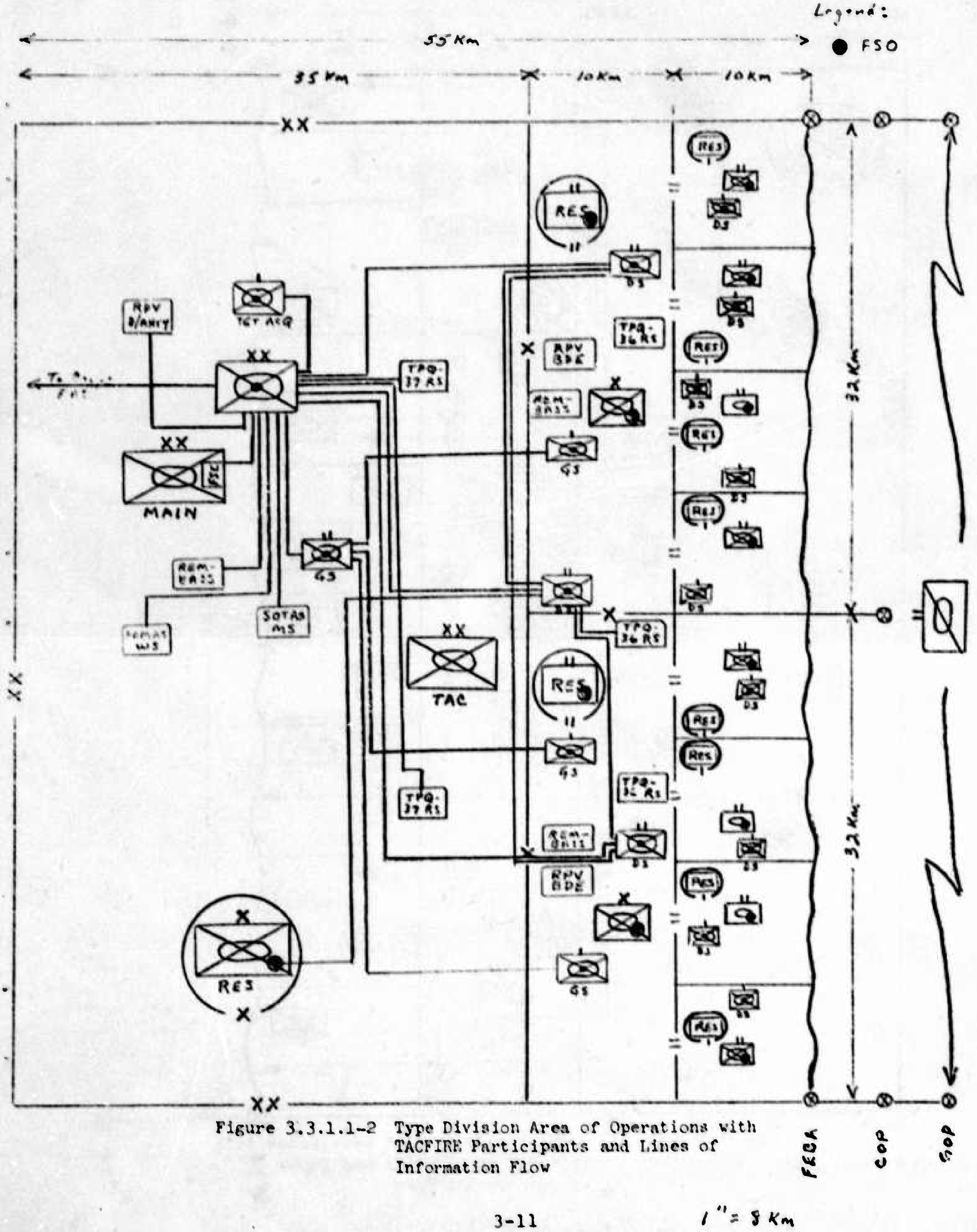

Figure 3.3.1.1-2 Type Division Area of Operations with TACFIRE Participants and Lines of Information Flow

1" = 8 Km

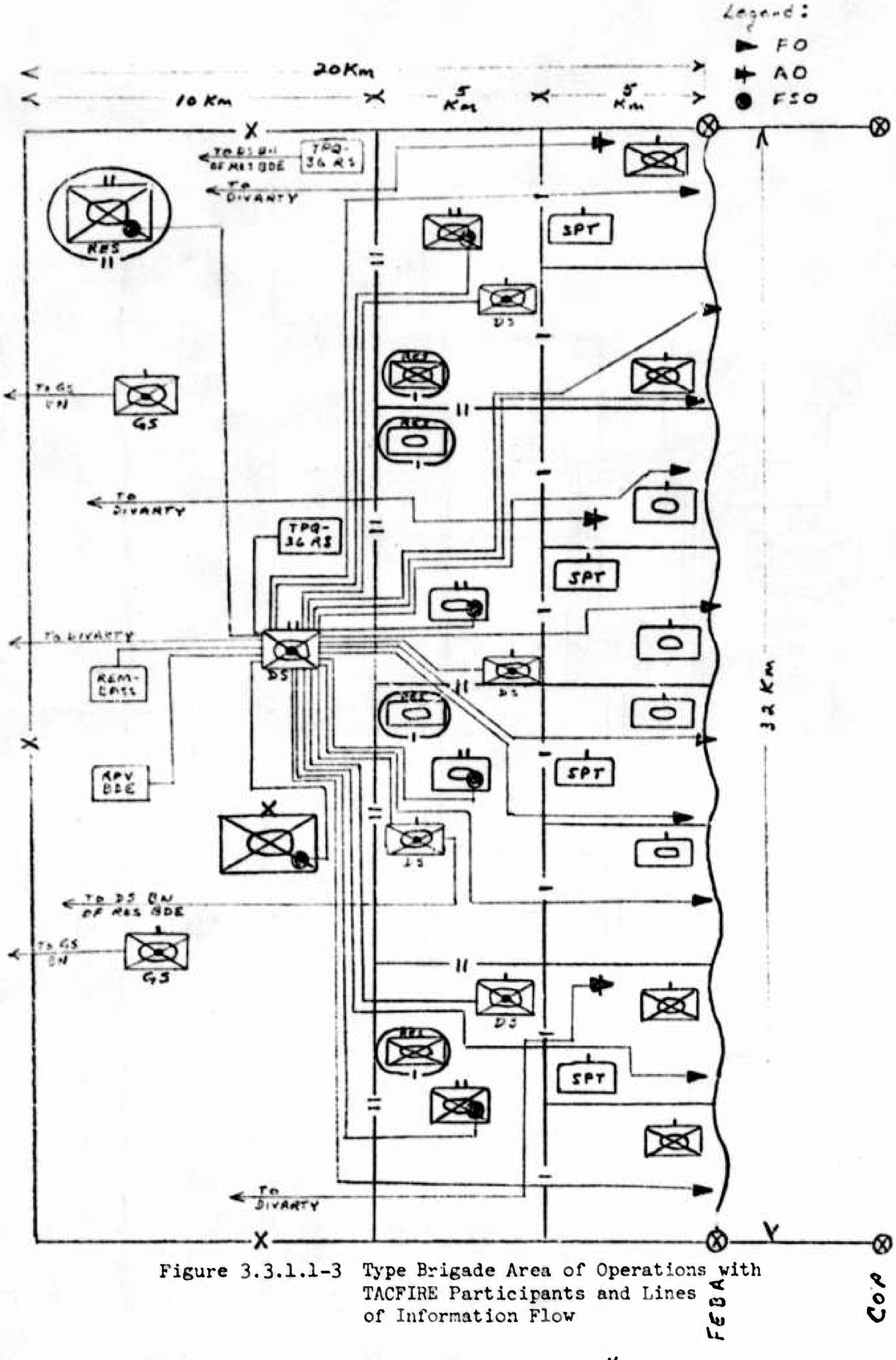

Figure 3.3.1.1-3 Type Brigade Area of Operations with TACFIRE Participants and Lines of Information Flow

Division Slice (Middle Div):

Division Main (FSE)	DM2
Target Acquisition Btry	TAB
RPV DivArty	RPD
REMBASS (Div)	RED
FAMAS (Div)	FAD
SOTAS (Div)	SOD
TPQ-37 (Upper)	T71
TPQ-37 (Lower)	T72
GS Bn	GSB
Bde Reserve (FSO)	BF3
Bde (FSO) (Upper)	BF1
Bde (FSO) (Lower)	BF2
DS Bn (Upper)	DS1
DS Bn (Middle)	DS3
DS Bn (Lower)	DS2

Brigade Slice (Lower Brigade):

TPQ-36 (Upper)	T63
TPQ-36 (Lower)	T62
REMBASS (BDE)	REB
RPV (BDE)	RPB
GS Btry (Upper)	GS1
GS Btry (Middle)	GS2
GS Btry (Lower)	GS3

Bn Reserve (FSO)	FS5
Bn (FSO) (Upper)	FS1
Bn (FSO) (Upper Middle)	FS2
Bn (FSO) (Lower Middle)	FS3
Bn (FSO) (Lower)	FS4
DS Btry (Upper)	AB1
DS Btry (Upper Middle)	AB2
DS Btry (Lower Middle)	AB3
DS Btry (Lower)	AB4
Artillery Airborne Observer (Upper)	AO1
Artillery Airborne Observer (Middle)	AO2
Artillery Airborne Observer (Lower)	AO3
Forward Observer (Indicated from Top to bottom, respectively)	FO1 thru FO10

Note: The designations in parenthesis as upper, middle, lower, etc., refer to the participants relative position on the particular schematic.

Since we are dealing with divison and brigade slices, the quantity of participants and data relating thereto must be adjusted to allow for the fact that there are three brigades per division and four division in the corps.

By assignment of the codes, it is now possible to indicate any set of participants by combining the two sets of codes representing the two participants separated by a hyphen, (i.e. if we are discussing the distance between the lower brigade FSO and the DS battalion supporting the brigade, the reference would be BF2-DS2).

3.3.1.1.2 Approximate Distance. Table 3.3.1.1.2-1 depicts the approximate distances that exist between participants as depicted on the three schematics.

3.3.1.1.3 Maximum Distances. Table 3.3.1.1.3-1 depicts the maximum distances between any set of participants. In determining these distances, consideration was given to the largest approximate distance for any set of participants in table 3.3.1.1.2-1 as well as what is considered the worst possible case based on knowledge derived from past military experience.

Taken From Figure No.	Participants	Approx. Dist. (Km)
3.3.1.1-1	CTF - DA4	83
3.3.1.1-1	CTF - CLB	28
3.3.1.1-1	CTF - DA1	100
3.3.1.1-1	CTF - DA2	65
3.3.1.1-1	CTF - DA3	44
3.3.1.1-1	CLB - LB1	55
3.3.1.1-1	CLB - LB2	19
3.3.1.1-1	CLB - LB3	65
3.3.1.1-2	DM2 - DA2	8
3.3.1.1-2	DA2 - RPD	8
3.3.1.1-2	DA2 - TAB	6
3.3.1.1-2	DA2 - RED	13
3.3.1.1-2	DA2 - FAD	18
3.3.1.1-2	DA2 - SOD	15
3.3.1.1-2	DA2 - T71	11
3.3.1.1-2	DA2 - T72	29
3.3.1.1-2	DA2 - GSB	12
3.3.1.1-2	DA2 - DS1	27
3.3.1.1-2	DA2 - DS2	40
3.3.1.1-2	DA2 - DS3	25
3.3.1.1-2	BF3 - DS3	32
3.3.1.1-2	GSB - GS1	18
3.3.1.1-2	GSB - GS2	21
3.3.1.1-2	GSB - GS3	32

Table 3.3.1.1.2-1 Table of Approximate Distances (cont'd)

Taken From Figure No.	Participants	Approx. Dist (Km)
3.3.1.1-2	DS1 - DS2	38
3.3.1.1-2	DS1 - DS3	22
3.3.1.1-2	DS2 - DS3	17
3.3.1.1-2	DS3 - T63	6
3.3.1.1-3	DS2 - T62	3
3.3.1.1-3	DS2 - REB	5
3.3.1.1-3	DS2 - RPB	6
3.3.1.1-3	DS2 - BF2	6
3.3.1.1-3	DS2 - FS1	13
3.3.1.1-3	DS2 - FS2	5
3.3.1.1-3	DS2 - FS3	6
3.3.1.1-3	DS2 - FS4	14
3.3.1.1-3	DS2 - FS5	14
3.3.1.1-3	DS2 - AB1	12
3.3.1.1-3	DS2 - AB2	7
3.3.1.1-3	DS2 - AB3	7
3.3.1.1-3	DS2 - AB4	12
3.3.1.1-3	AO1 - DA2	38
3.3.1.1-3	AO2 - DA2	44
3.3.1.1-3	AO3 - DA2	52
3.3.1.1-3	FO1 - DS2	18
3.3.1.1-3	FO2 - DS2	16
3.3.1.1-3	FO3 - DS2	14
3.3.1.1-3	FO4 - DS2	13

Table 3.3.1.1.2-1 Table of Approximate Distances (cont'd)

Taken From Figure No.	Participants	Approx. Dist (Km)
3.3.1.1-3	F05 - DS2	13
3.3.1.1-3	F06 - DS2	13
3.3.1.1-3	F07 - DS2	13
3.3.1.1-3	F08 - DS2	14
3.3.1.1-3	F09 - DS2	17
3.3.1.1-3	F010 - DS2	20

Table 3.3.1.1.3-1 Table of Maximum Distances

Participants Links	Max Dist (Km)
Corps (FAS) - DivArty	100
Corps (FAS) - LANCE Bn	30
LANCE Bn - LANCE Btry	65
Div (FSE) - DivArty	40
DivArty - Tqt Acq. Btry	10
DivArty - RPV (DivArty)	20
DivArty - REMBASS (Div)	15
DivArty - FAMAS (Div)	20
DivArty - SOTAS (Div)	15
DivArty - TPQ-37	30
DivArty - GS Bn	20
DivArty - DS Bn	40
GS Bn - GS Btry	35
DS Bn - DS Bn	40
DS Bn - TPQ-36	10
DS Bn - REMBASS (BDE)	10
DS Bn - RPV (BDE)	10
DS Bn - BDE FSO	10
DS Bn - Bn FSO	15
DS Bn - DS Btry	15
Air Observer - DivArty	50
FO - DS Bn	20

3.3.1.2 Connectivity. Figures 3.3.1.2-1 depicts a connectivity diagram for TACFIRE. It shows all the various TACFIRE participants with interconnecting lines denoting the method of traffic flow between participants. When used with figures 3.3.1.1.-1, 3.3.1.1-2, and 3.3.1.1-3, these diagrams provide a basis for determination of where in the network relays may be required because of the distance separation of participants. The lines of connectivity are based on information flow that currently exists in TACFIRE by use of tactical FM radio equipment. The FM radio equipment is used to provide command and fire direction nets among elements of the field artillery family of participants. With the institution of JTIDS, it can be expected that greater connectivity will be achieved by providing the capability for those participants who are not now directly connected to be able to derive information of interest to them directly from the JTIDS network without the need for relay through another participant. For example, as it currently stands, a brigade FSO desiring artillery target intelligence which is maintained by the DivArty computer would request the information from the direct support battalion supporting that Brigade. The DS battalion would relay the request to DivArty. The response from DivArty would be sent back to the particular DS battalion for relay to the brigade FSO. With JTIDS, the brigade FSO would have the capability to request the information directly from the DivArty computer.

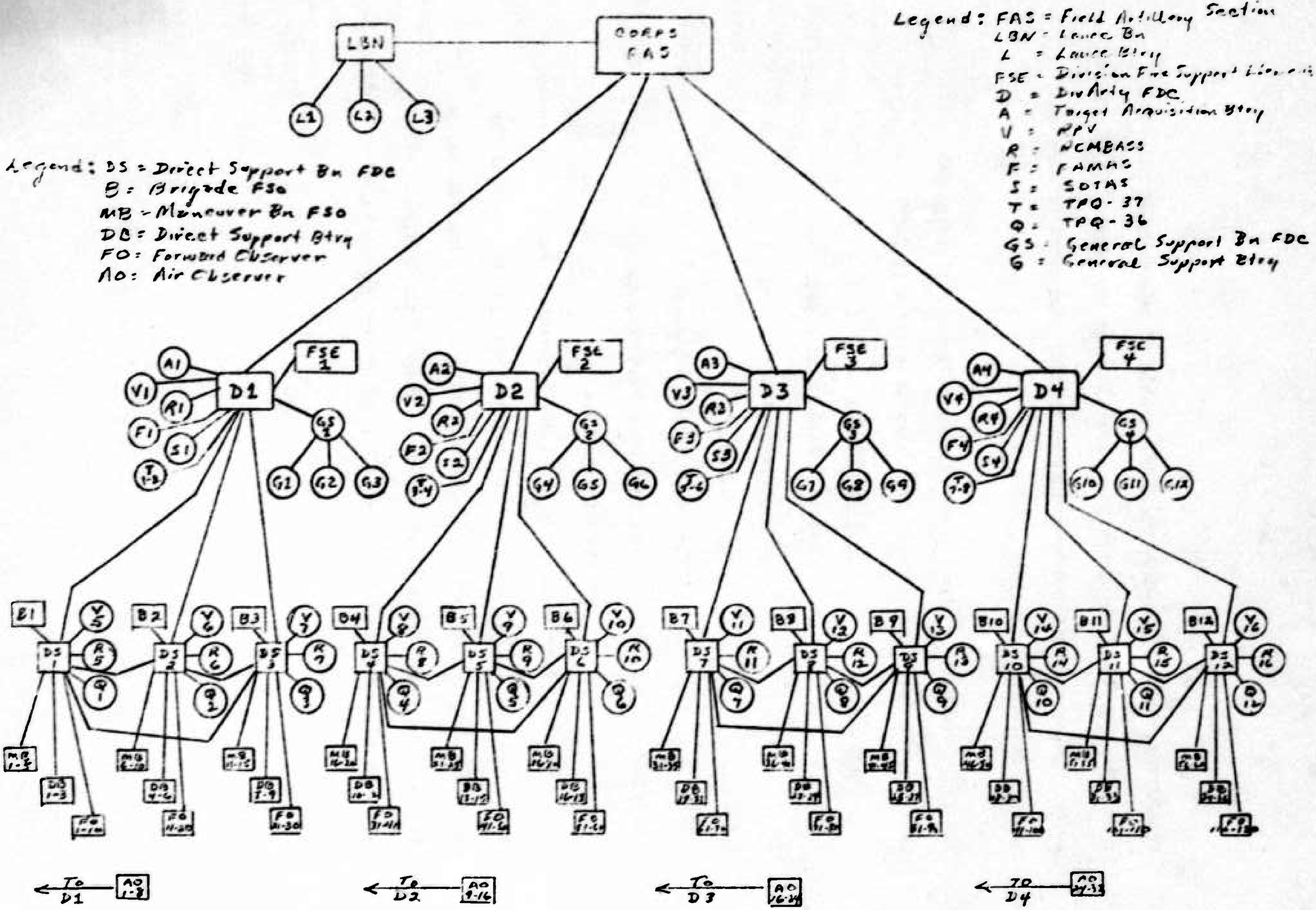

Figure 3.3.1.2-1 TACFIRE Connectivity Diagram

With JTIDS, all participants shall be capable of reception of emissions from any other terminal within the constraints of the terrain, transmitter power, operator controlled transmission privacy, and operator selected message filtering criteria.

3.3.1.3 Information Types. The following figures depict typical data flows between participants for various classes of TACFIRE missions:

Figure No.	TACFIRE Mission
3.3.1.3-1	Immediate Fire Mission Data
3.3.1.3-2	Intelligence Data
3.3.1.3-3	Fire Planning
3.3.1.3-4	Fire Coordination Measures
3.3.1.3-5	Artillery Fire Unit Information
3.3.1.3-6	Known Point Data

These data flow diagram show the types of information that flows between participants of TACFIRE but does not include such participants as the Target Acquisition Battery, RPV, REMBASS, FAMAS, SOTAS, FIREFINDER, and the Air Observers. Table 3.3.1.3-1 shows these other TACFIRE participants and indicates the typical type of information flow.

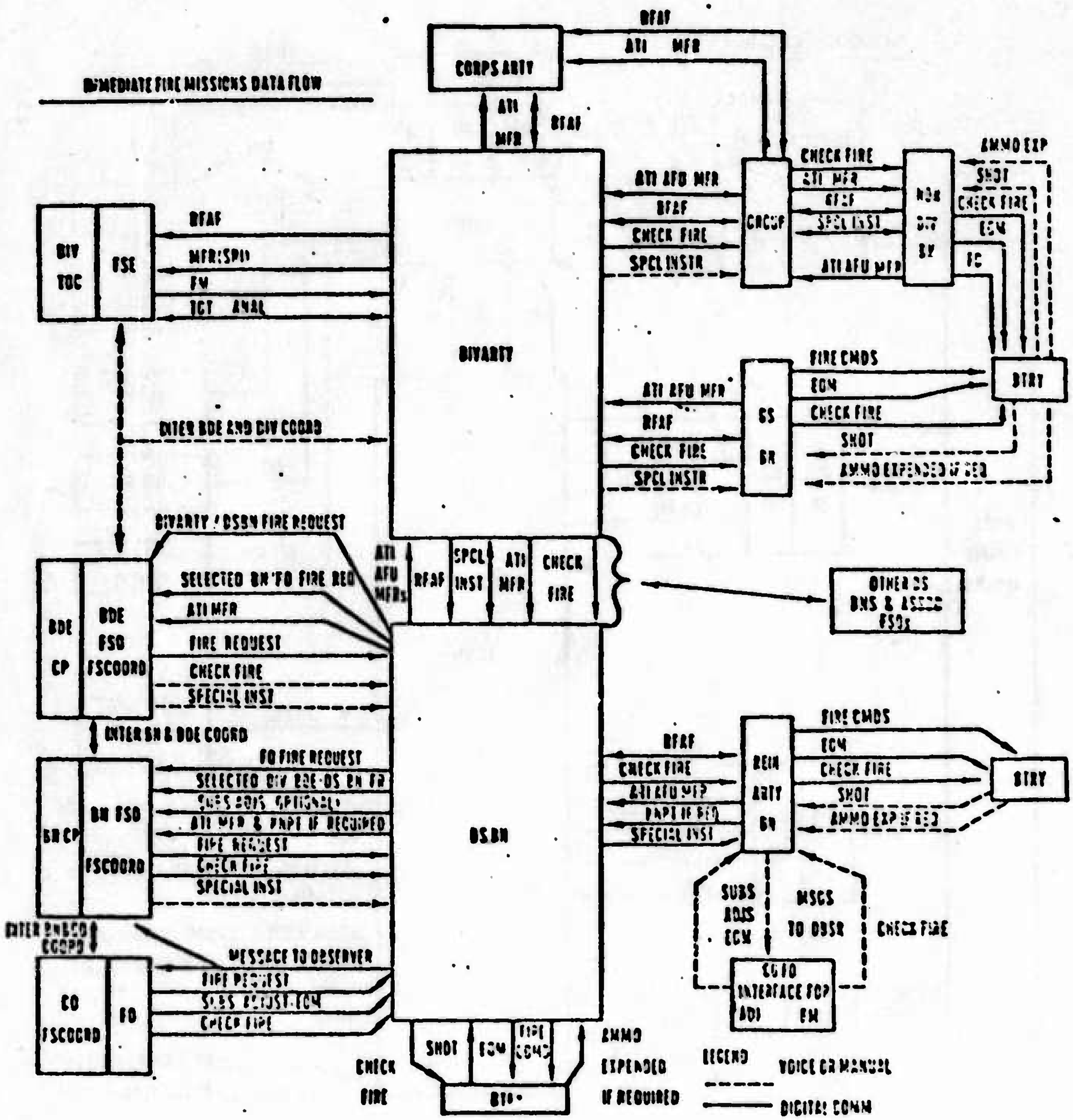

Figure 3.3.1.3-1 Immediate Fire Missions Data Flow

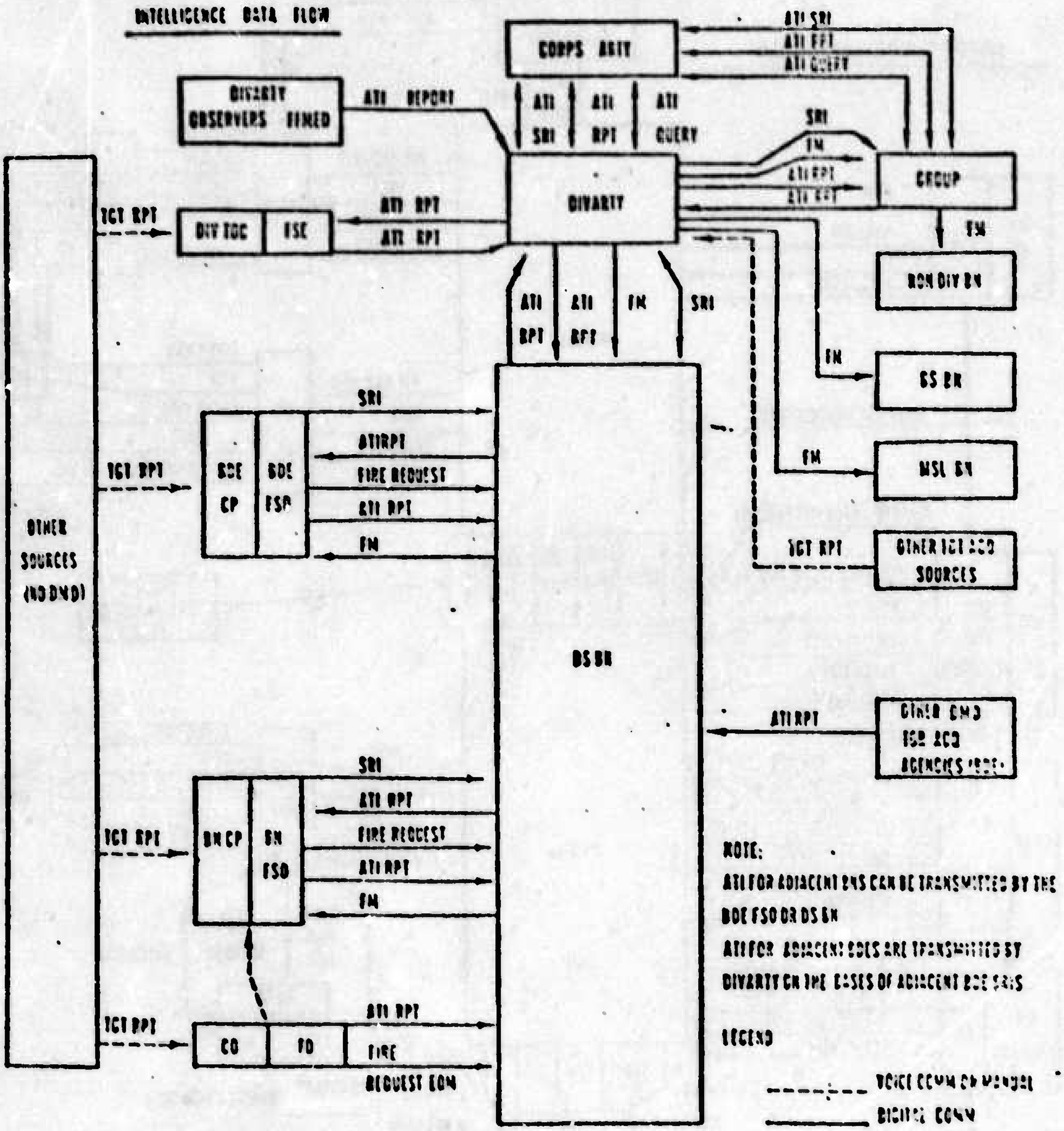

Figure 3.3.1.3-2 Intelligence Data Flow

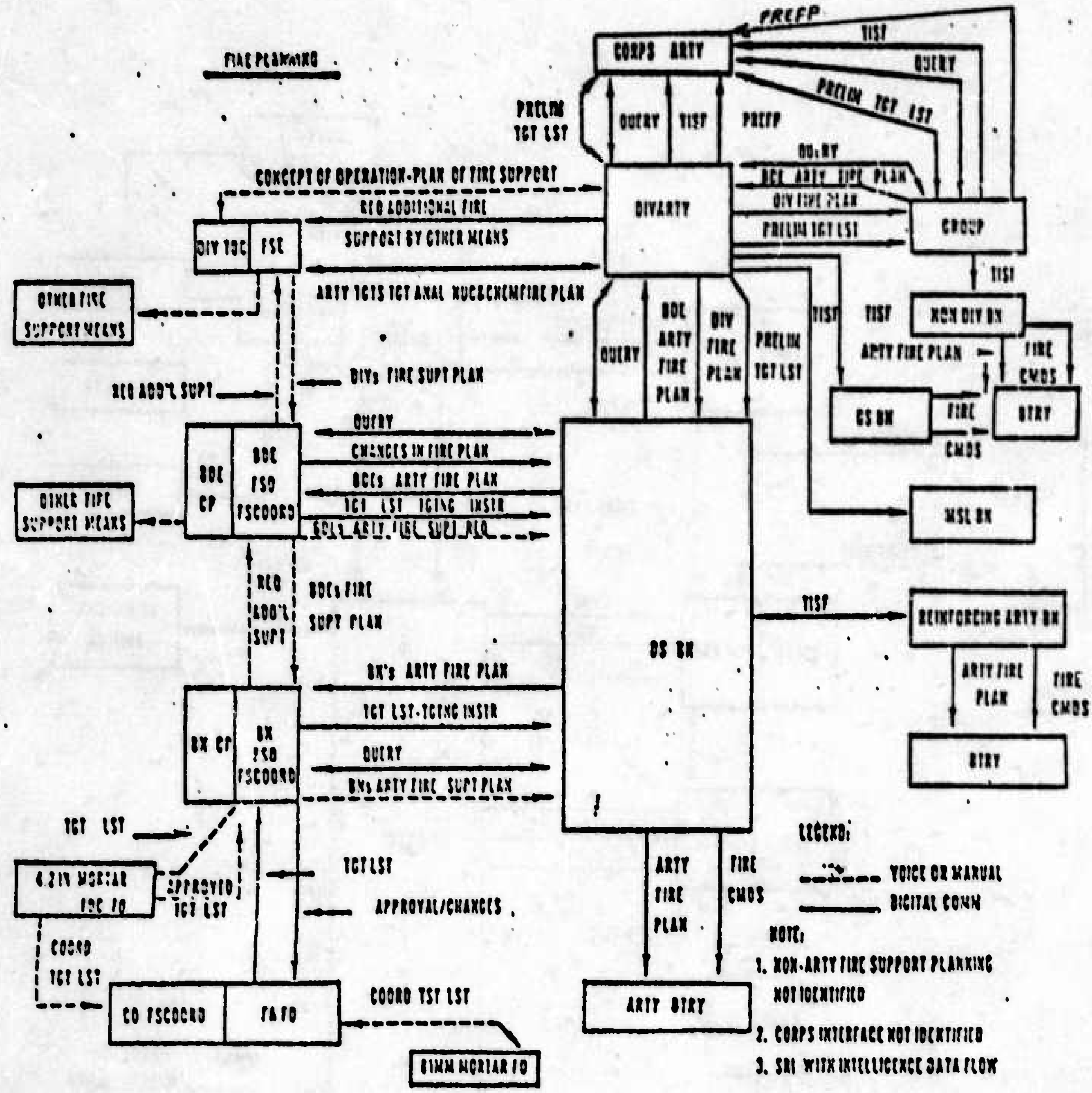

Figure 3.3.1.3-3 Fire Planning Data Flow

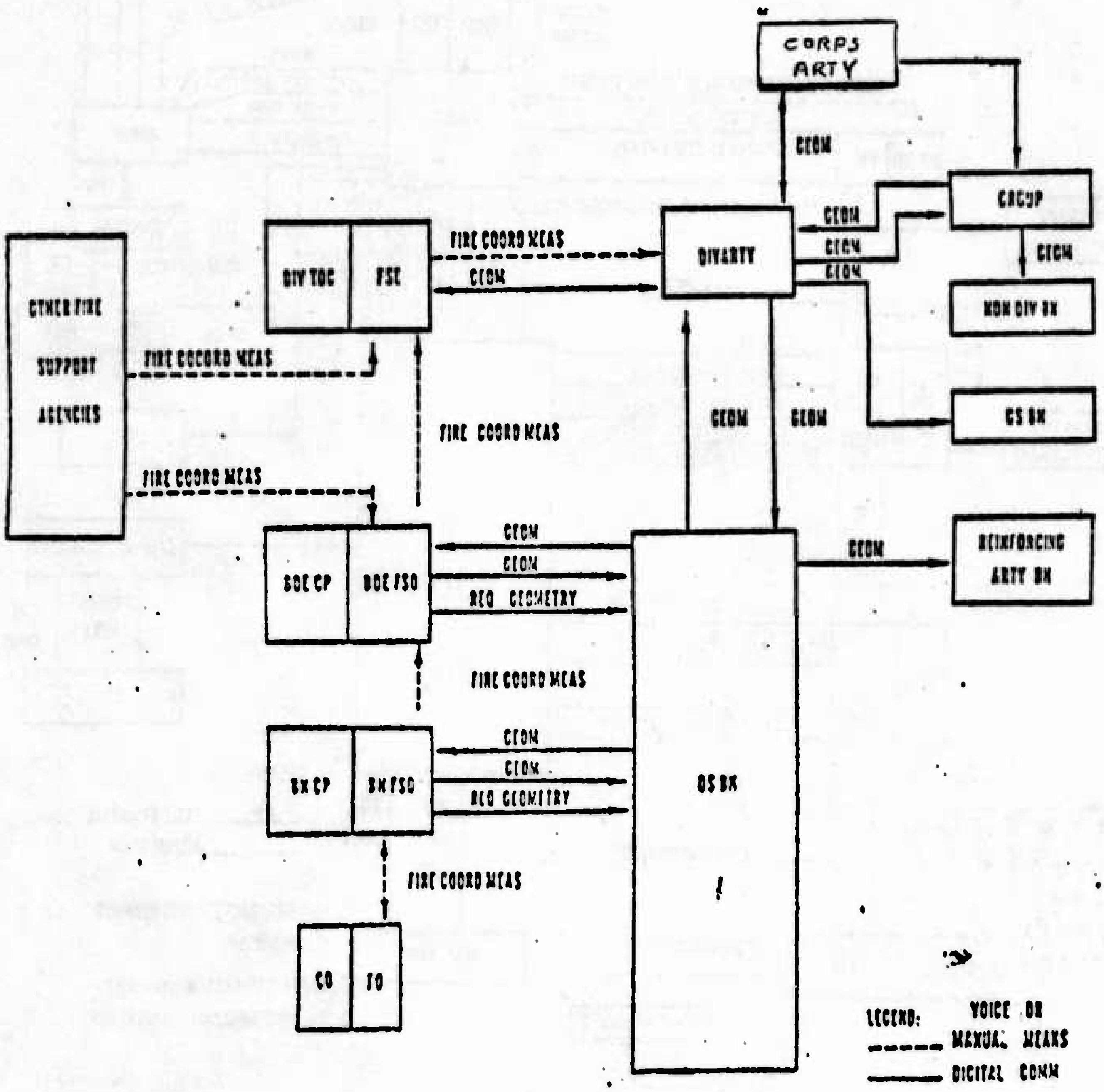

Figure 3.3.1.3-4 Fire Coordination Measures Data Flow

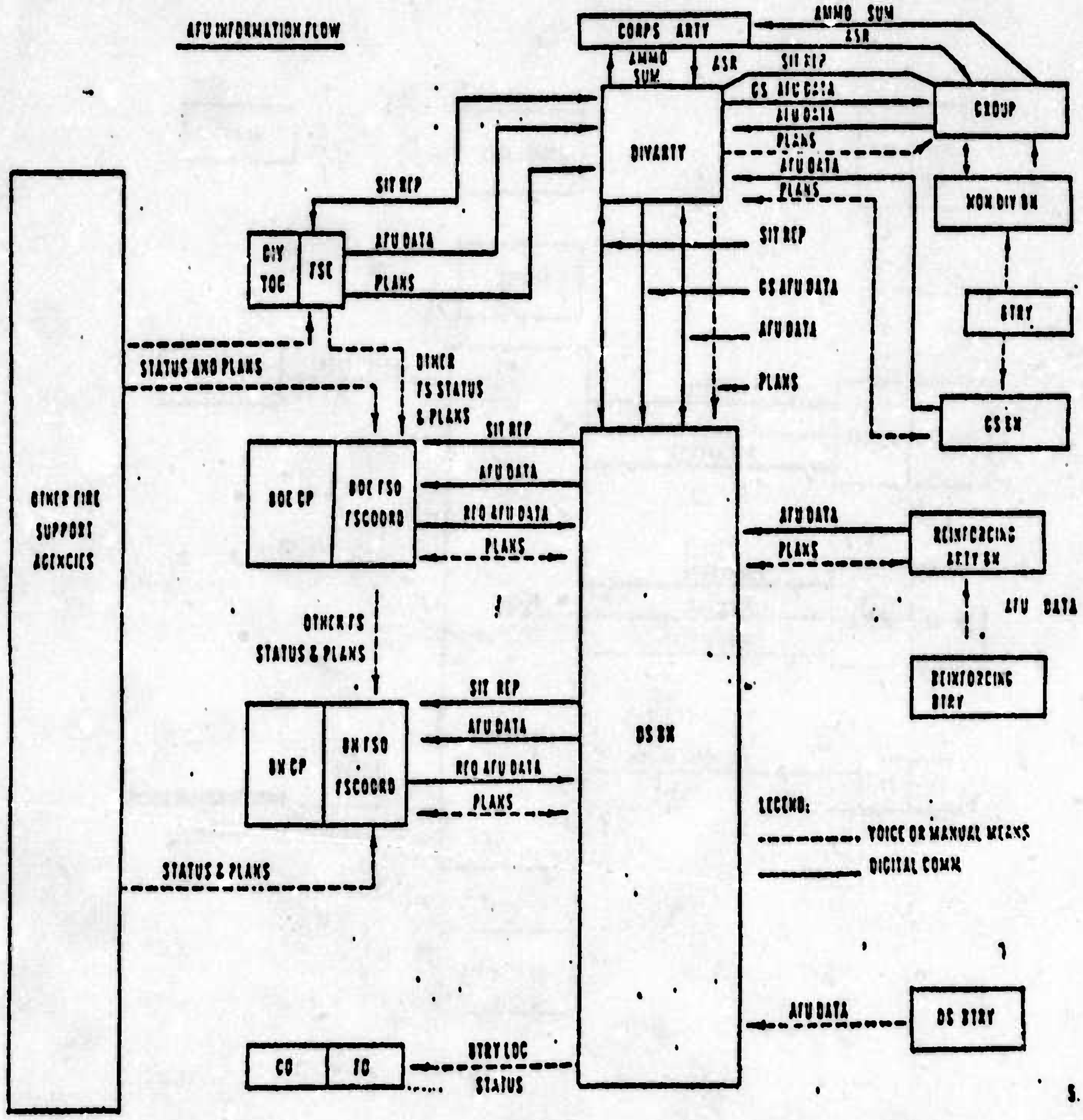

Figure 3.3.1.3-5 Artillery Fire Unit Information Flow

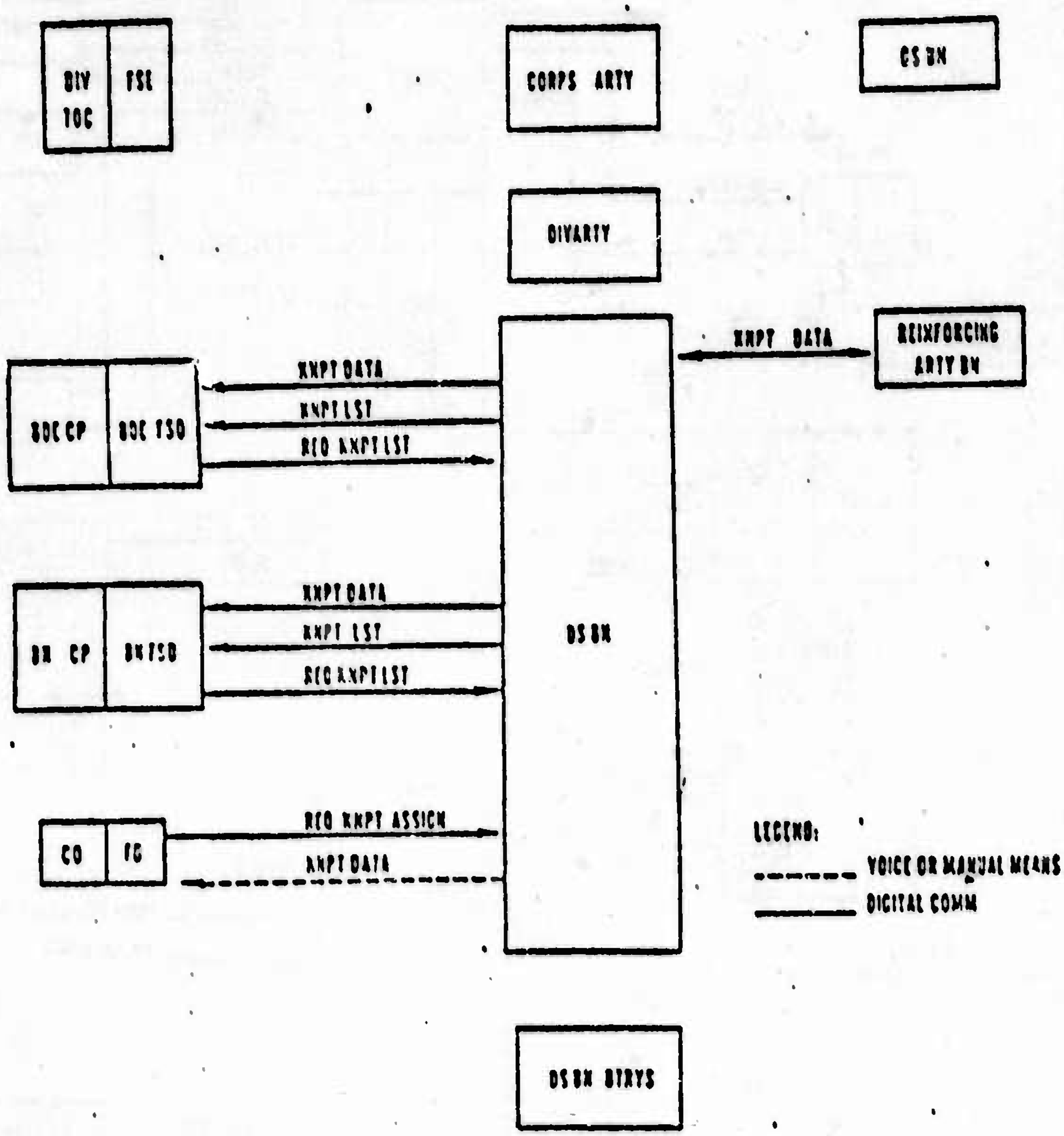

Figure 3.3.1.3-6 Known Point Data Flow

Table 3.3.1.3-1 Information Flow (TACFIRE)

Participants Link	Type of Data
DivArty → Tgt Acq Btry	Intelligence Data
	Target Reports
	Fire Plans
Tgt Acq Btry → DivArty	Intelligence Data
	Target Reports
	Sound Ranging Reports
	Flash Ranging Reports
DivArty/DS Bn → RPV	Mission Request
	Special instructions
RPV → DivArty/DS Bn	Intelligence Data
	Fire Adjustment Data
DivArty/DS Bn → REMBASS	Mission Request
	Special Instructions
REMBASS → DivArty/DS Bn	Intelligence Data
	Request for fire
DivArty → FAMAS	Request for information
	Special Instructions
FAMAS → DivArty	Meteorological Data
DivArty/DS Bn → FIREFINDER	Mission Request
	Fire Mission Data
	Special Instructions
	Registration Data

Table 3.3.1.3-1 Information Flow (TACFIRE) (cont'd)

FIREFINDER → DivArty/DS Bn	Registration Data
	Intelligence Data
	Fire Adjustment Data
	Request for fire
DivArty → Air Observer	Message to Observer
	Special Instructions
Air Observer → DivArty	Request for fire
	Intelligence Data
	Registration Data
	Fire Adjustment Data

3.3.1.4 <u>Traffic Flow</u>. Within a given tactical situation, it can be expected that a certain volume of data will pass between participants. Table 3.3.1.4-1 depicts typical volume figures between participants operating in a TACFIRE enviroment. These volume figures were developed as estimates based on information contained in the Tactical Automation Appraisal (TAA II) Report. The information shown depicts the volume that is estimated within a 24 hour period, whether the transmission made is data or voice, and the average length of the transmission. By applying a multiplication factor for the number of such links that would be available in a Division area or a corps area it is possible to compute the estimated total capacity for a Division on Corps.

Table 3.3.1.4-1 Traffic Flow (TACFIRE)

Participant Links	Xmit Mode	Avg Msgs Per 24 hrs	Avg Length of Xmit
Corps FAS	D	30	10 sec.
to DivArty	V	23	3 min.
DivArty to	D	100	10 sec.
Corps FAS	V	54	3 min.
Corps FAS	D	120	29 sec.
to Lance Bn	V	15	2.5 min.
Lance Bn to	D	120	29 sec.
Corps FAS	V	15	2.5 min.
Lance Bn to	D	47	2.5 sec
Lance Btry	V	3	2.5 min
Lance Btry	D	47	2.5 sec
to Lance Bn	V	3	2.5 min
DivArty to	D	240	28 sec
Div FSE	V	27	3 min
Div FSE	D	240	28 sec
to DivArty	V	27	3 min
DivArty to	D	400	.05 sec
Tgt Acq. Btry	V	320	30 sec
Tgt Acq. Btry	D	400	.05 sec
to DivArty	V	320	30 sec
DivArty to	D	172	3.4 sec
RPV GCS	V	60.	20 sec

Table 3.3.1.4-1 (cont'd)

RPV GSC	D	172	3.4 sec
to DivArty	V	60	20 sec
DivArty to	D		
REMBASS	V	20	30 sec
REMBASS	D	20	15 sec
to DivArty	V		
DivArty to	D	12	.5 sec
FAMAS	V		
FAMAS	D	36	3 min
to DivArty	V		
DivArty to	D		
SOTAS GCS	V	8	30 sec
SOTAS GCS	D	250	.5 sec
to DivArty	V	8	20 sec
DivArty to	D	120	29 sec
GS Bn	V	15	2.5 min
GS Bn	D	120	29 sec
to DivArty	V	15	2.5 min
GS Bn to	D	47	2.5 sec
GS Btry	V	3	2.5 min
GS Btry	D	47	2.5 sec
to GS Bn	V	3	2.5 min

Table 3.3.1.4-1 (cond't)

DivArty to	D	350	29 sec
DS Bn	V	85	4 min
DS Bn	D	350	29 sec
to DivArty	V		
DivArty to	D	150	2 sec
TPQ-37	V		
TPQ-37	D	150	3.4 sec
to DivArty	V		
DS Bn to	D	140	2.5 sec
DS Btry	V	10	2.5 min
DS Btry	D	140	2.5 sec
to DS Bn	V	10	2.5 min
DS Bn to	D	185	9 sec
FSO	V		
FSO	D	185	9 sec
DS Bn	V		
DS Bn to	D	200	10 sec
DS Bn	V		
DS Bn to	D	150	2 sec
TPQ-36	V	20	2.5 min
TPQ-36	D	150	3.4 sec
to DS Bn	V	20	3 min
DS Bn to	D	190	1 sec
RPV GCS	V		

Table 3.3.1.4-1 (cond't)

RPV GCS to DS Bn	D V	190	3.4 sec
DS Bn to REMBASS	D V	20	30 sec
REMBASS to DS Bn	D V	20	15 sec
I ; Bn to FO	D V	157	2.5 sec
FO to DS Bn	D V	157	2.5 sec
DivArty to AO	D V	40	2.5 sec
AO to DivArty	D V	40	2.5 sec

3.3.1.5 Timing Requirements. Table 3.3.1.4-1, in addition to providing the average message volume per 24 hour period, provides the average length of time it takes to transmit a message from one participant to another. In TACFIRE, the serial bit rate may be 600 to 1200 bits per second. Message lengths will vary dependent upon the participant link discussed. For the forward observers and the air observers who will be using the DMD, the messages they transmit and receive are fixed format with a maximum of 44 characters. Participants links other than those with FO's and AO's would be using the variable format message with a maximum length of 517 charcters. These maximum lengths do not take into consideration crypto sync overhead which would add about 80 characters. It is estimated that an average message using the variable format will probably have a length of 320 characters. Printout reports generated by the computors, essentially at DivArty, could be greater than 1 normal variable format message. Here,it is estimated that the average transmission of such printouts would be equivalent to 3 normal messages. For each message transmitted in the TACFIRE system, an ACK or a NACK message, consisting of 16 characters, must be transmitted in order to acknowledge receipt or indicate a bad transmission. In the case of a NACK, a retransmission of the original message would be necessary. The TACFIRE system uses the ASCII character format with 12 bits representing a character. To compare TACFIRE message length with JTIDS capabilities it is necessary to convert the lengths in characters to length in bits.

Therefore, a DMD message used by an FO or AO with a maximum length of 44 characters converts to 576 bits and a variable format message with a maximum length of 517 character converts to 6,204 bits. If we then relate these maximum bit lengths to the number of information bits that can be accommodated in a JTIDS time slot, we find that TACFIRE messages cannot be handled in one time slot. In the error detection and correction made, JTIDS can accommodate 225 information bits in a time slot while in the non-error detection and correction made, 450 information bits can be accommodated in a time slot. Application of these factors indicates that a DMD message would require 2 or 3 time slots depending upon the type made employed. A variable format message would require 14 or 27 time slots depending upon the type made employed. It is possible that with compression coding a DMD message could be handled within one JTIDS time slot. Not being able to operate within the confines of one time slot means that JTIDS operation in TACFIRE would be essentially done in the unformatted message mode. In this mode, JTIDS is merely providing security and antijam for messages and the basic value of the system (information distribution to a community of users) is not effectively used.

3.3.2 MIFASS.

This paragraph discusses the various factors in relationship to the participants operating in a MIFASS network.

3.3.2.1 Geographical Relationships. Figures 3.3.2.1-1 (Marine Amphibious Force Area) and 3.3.2.1-2 (lower Marine Regiment slice) depict typical deployment of MIFASS participants and shows the information flow paths by which MIFASS data is passed back and forth between the participants. It is assumed that the Marine Amphibious Force (MAF) is composed of one Marine Division with three regiments (two on line and one in reserve). The regiments consist of three battalions (two on line and one in reserve). The artillery of the reserve Regiment is committed in a reinforcing role. Observers of the reserve battalions are deployed with the forward battalions of each regiment. It is further assumed that the MAF has been in operation for some time, has established a beachhead, and moved inland to the position shown on the schematic. Naval Gunfire (NGF) ships have been supporting the landing force in their operations and are now lying off shore to provide missile support capability. These NGF ships are operating in general support of the regiments. Although in a given situation more NGF ships may be employed, it is assumed in this scenario that three cruisers are employed. There would probably also be an aircraft carrier deployed to provide direct air support, although not shown in the schematic.

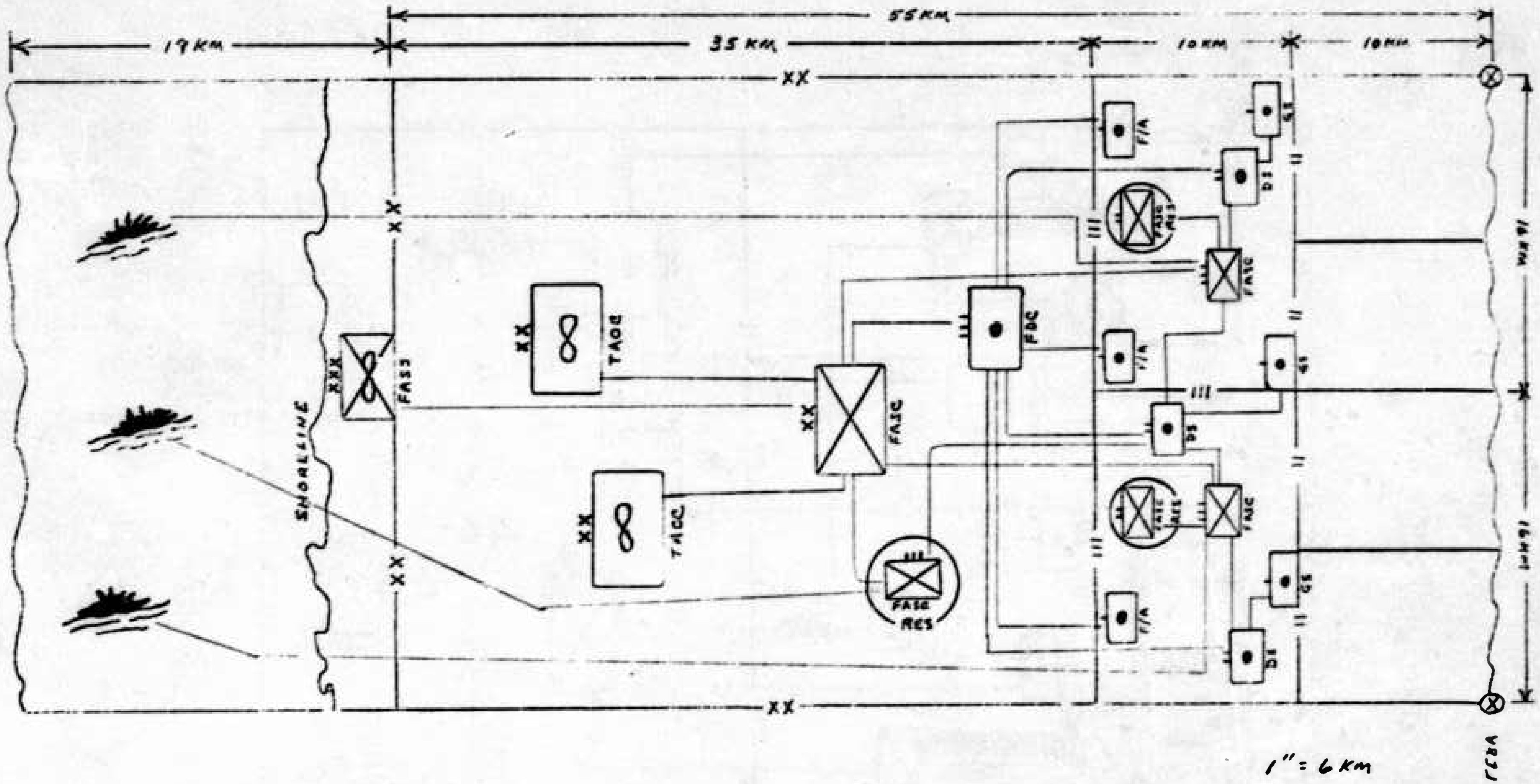

Figure 3.3.2.1-1 Type Marine Amphibious Force Area of Operation with MIFASS Participants and Lines of Information Flow

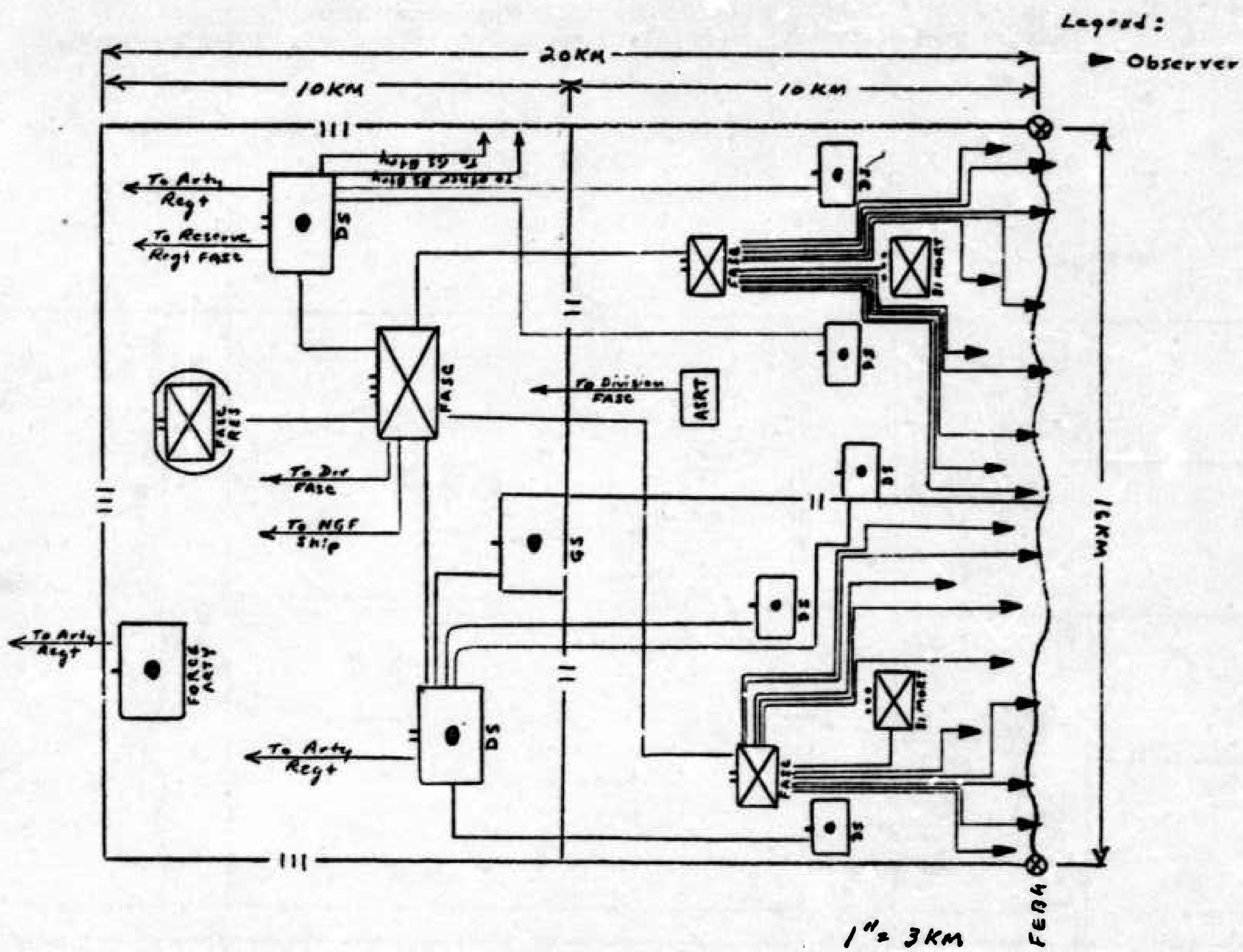

Figure 3.3.2.1-2 Type Marine Regiment Area of Operation with MIFASS Participants and Lines of Information Flow

3.3.2.1.1 Identity Codes. To further facilitate identity of the participants, each is assigned a code as follows:

Participants	Code
MAF:	
MAF FASS	MAF
NGF Ship #1 (Upper)	NG1
NGF Ship #2 (Middle)	NG2
NGF Ship #2 (Lower)	NG3
TACC	TAC
TAOC	TAO
Division:	
Div FASC	DFA
Reserve Regt FASC	RF3
Artillery Regt	ART
Regt FASC (Upper)	RF1
Regt FASC (Lower)	RF2
Force Arty Btry (Upper)	FA1
Force Arty Btry (Middle)	FA2
Force Arty Btry (Lower)	FA3
DS Bn (Upper)	DS1
DS Bn (Middle)	DS3
DS Bn (Lower)	DS2
Regimental Slice (Lower Regt):	
Reserve Bn FASC	BF3
GS Btry	GS2
DS Btry (Upper)	D32

DS Btry (Upper Middle)	D33
DS Btry (Middle)	D21
DS Btry (Lower Middle)	D22
DS Btry (Lower)	D23
81 Mortar Platoon (Upper)	MP1
81 Mortar Platoon (Lower)	MP2
Observers (Indicated from Top to bottom)	OB1-OB20
ASRT	AS2
Bn FASC (Upper)	BF1
Bn FASC (Lower)	BF2

Note: The designations in parentheses as upper, middle, lower, etc. refer to the participants relative position on the particular schematic.

Since we are dealing with a regimental slice, the quantity of participants and data relating thereto must be adjusted to allow for the fact that there are three regiments in the division.

In assignment of the codes, it is now possible to indicate any set of participants by combining the two sets of codes representing the two participants separated by a hyphen (i.e. if we are discussing the distance between the lower regiment FASC and the DS battalion supporting that regiment, the reference would be RF2-DS2).

3.3.2.1.2 Approximate Distances. Table 3.3.2.1.2-1 depicts the approximate distances that exist between the participants depicted in the two schematics.

Table 3.3.2.1.2-1 Table of Approximate Distances

Taken from Figure No.	Participants	Approx. Dist. (Km)
3.3.2.1 - 1	MAF - DFA	24
3.3.2.1 - 1	NG1 - RF1	50
3.3.2.1 - 1	NG2 - RF3	40
3.3.2.1 - 1	NG3 - RF2	50
3.3.2.1 - 1	TAC - DFA	12
3.3.2.1 - 1	TAO - DFA	15
3.3.2.1 - 1	DFA - RF1	20
3.3.2.1 - 1	DFA - RF2	19
3.3.2.1 - 1	DFA - RF3	9
3.3.2.1 - 1	DFA - ART	9
3.3.2.1 - 1	ART - FA1	12
3.3.2.1 - 1	ART - FA2	6
3.3.2.1 - 1	ART - FA3	16
3.3.2.1 - 1	ART - DS1	14
3.3.2.1 - 1	ART - DS2	21
3.3.2.1 - 1	ART - DS3	10
3.3.2.1 - 1	DS1 - RF1	5
3.3.2.1 - 1	DS3 - RF1	8
3.3.2.1 - 1	DS3 - RF2	5
3.3.2.1 - 1	DS3 - RF3	15
3.3.2.1 - 1	DS2 - RF2	7
3.3.2.1 - 2	RF2 - BF3	5
3.3.2.1 - 2	RF2 - BF1	7
3.3.2.1 - 2	RF2 - BF2	11

Table 3.3.2.1.2-1 Table of Approximate Distances (Cont'd)

3.3.2.1 - 2	DS3 - D32	11
3.3.2.1 - 2	DS3 - D33	12
3.3.2.1 - 2	DS2 - D21	11
3.3.2.1 - 2	DS2 - D22	7
3.3.2.1 - 2	DS2 - D23	8
3.3.2.1 - 2	DS2 - GS2	5
3.3.2.1 - 2	BF1 - MP1	4
3.3.2.1 - 2	BF1 - OB1	7
3.3.2.1 - 2	BF1 - OB2	8
3.3.2.1 - 2	BF1 - OB3	7
3.3.2.1 - 2	BF1 - OB4	6
3.3.2.1 - 2	BF1 - OB5	7
3.3.2.1 - 2	BF1 - OB6	6
3.3.2.1 - 2	BF1 - OB7	7
3.3.2.1 - 2	BF1 - OB8	8
3.3.2.1 - 2	BF1 - OB9	8
3.3.2.1 - 2	BF1 - OB10	8
3.3.2.1 - 2	BF2 - MP2	3
3.3.2.1 - 2	BF2 - OB11	7
3.3.2.1 - 2	BF2 - OB12	7
3.3.2.1 - 2	BF2 - OB13	6
3.3.2.1 - 2	BF2 - OB14	7
3.3.2.1 - 2	BF2 - OB15	6
3.3.2.1 - 2	BF2 - OB16	6
3.3.2.1 - 2	BF2 - OB17	5
3.3.2.1 - 2	BF2 - OB18	6

Table 3.3.2.1.2-1 <u>Table of Approximate Distances (Cont'd)</u>

3.3.2.1 - 2	BF2 - OB19	6
3.3.2.1 - 2	BF2 - OB20	5
3.3.2.1 - 2	AS2 - DFA	25

3.3.2.1.3 Maximum Distances. Table 3.3.2.1.3-1 depicts the maximum distance between any set of participants. In determining these distances, consideration was given to the largest approximate distance for any set of participants in table 3.3.2.1.2-1 as well as what is considered the worst possible case based on knowledge derived from past military experience.

3.3.2.2 Connectivity. Figure 3.3.2.2-1 depicts a connectivity diagram for MIFASS. It shows all the various TACFIRE participants with interconnectivity lines denoting the method of traffic flow between participants. When used with figure 3.3.2.1-1 and 3.3.2.1-2, these diagrams provide a basis for determination of where in the network relays may be required because of the distance separation of participants. The lines of connectivity are based on the normal flow of information within MIFASS using current communications means. With JTIDS, all participants shall be capable of reception of emissions from any other terminal within the constraints of the terrain, transmitter power, operator controlled transmission privacy, and operator selected message filtering criteria.

Table 3.3.2.1.3-1 Table of Maximum Distances

Participants Links	Max. Dist. (Km)
MAF (FASS) - Div (FASC)	25
TACC - Div (FASC)	15
TAOC - Div (FASC)	15
NGF Ship - Regt (FASC)	50
Div (FASC) - Regt (FASC)	20
Div (FASC) - Arty Regt (FDC)	10
Div (FASC) - ASRT	30
Arty Regt (FDC) - Force Arty Btry	20
Arty Regt (FDC) - DS Bn	25
Regt (FASC) - Bn (FASC)	15
Regt (FASC) - DS Bn	15
DS Bn - DS Btry	15
DS Bn - GS Btry	10
Bn (FASC) - 81 Mort. Plt	5
Bn (FASC) - Observer	10

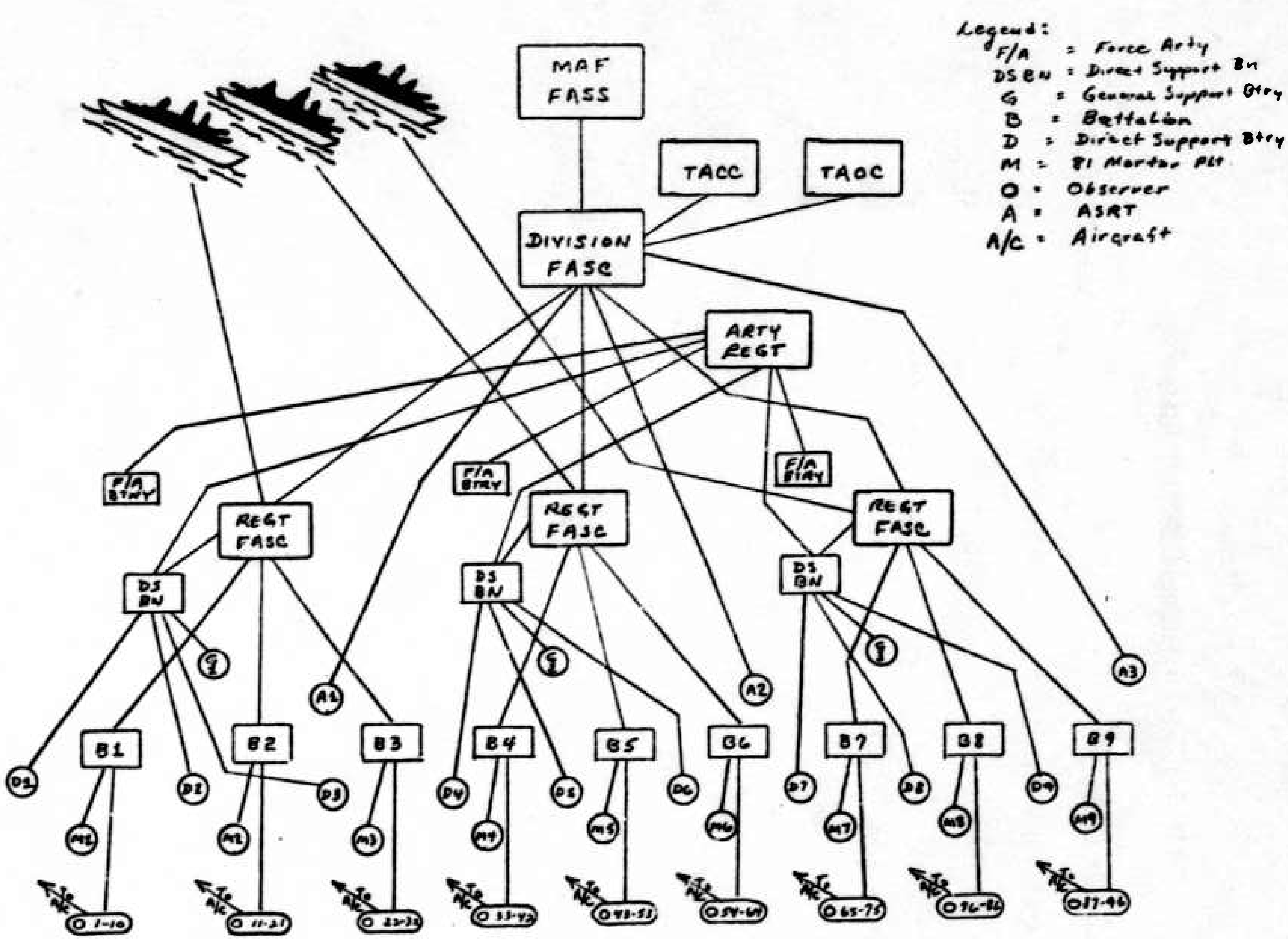

Figure 3.3.2.2-1 MIFASS Connectivity Diagram

3.3.2.3 Information Types. Table 3.3.2.3-1 provides some types of data that flow between participants operating in a MIFASS environment. This table does by no means contain all of the types of information that flow but only provides some of the typical types of flow.

3.3.2.4 Traffic Flow. Within a given tactical situation, it can be expected that a certain volume of data will pass between participant. Table 3.3.2.4-1 depicts estimated volume figures that can be expected to be handled by various MIFASS participants. These volume figures were developed as estimates based on information contained in the MIFASS Engineering Development Model System Specification. It is expected that peak hour volume will be about 10% of the total 24 hour volume.

Table 3.3.2.3-1 Types of Data Flow

Participant Link	Types of Data
TACC → SR FASC	Aircraft resources; Air track management information; Air defense information
SR FASC → TACC	Direct air support requests; Air track management information; Air defense information
TACC → TAOC	Air defense information
TAOC → TACC	Track data, Air defense information
TAOC → SR FASC	Weather; DAS coordination
SR FASC → TAOC	DAS coordination; Hazards to aircraft; weather.
SR FASC → ASRT	Hazards; weather; targets; Mission Data
ASRT → SR FASC	Hazards; weather; targets; Mission Data
FASC → FDC	Fire Orders; Fire Commands
FDC → FU	Fire Commands
FU → FASC	SHOT messages
Div FASC → Regt FDC	Fire Orders; Fire Commands; Call for fire
Div FASC → DS Bn FDC	Fire Orders; Fire Commands
Regt FDC → Force Arty Btry	Fire Commands
Regt FDC → DS Bn FDC	Call for fire
DS Bn FDC → DS Btry	Fire Command
Observer → Bn FASC	Call for fire; Subsequent Adjust; Tactical Air request; End of Mission
Bn FASC → Observer	Message to Observer; SHOT message

Table 3.3.2.4-1 Traffic Flow

Participants	Incoming Avg Msgs 24 hrs.	Incoming Msgs Peak hr	Outgoing Avg Msgs 24 hrs	Outgoing Msgs Peak Hr
MAF FASS	8324	832	2994	299
DIV FASC	9770	977	5882	588
REGT FASC	7284	728	5080	508
BN FASC	3478	348	3444	344
REGT FDC	8878	888	2834	283
BN FDC	6134	613	2588	259
OBSERVER	140	14	140	14

3.3.2.5 Timing Requirements. Speed of service is a measurement of time required to transfer information from one point to another. In all cases, time is measured from the time the last bit of a message enters an orignating switch until the message has transited one intermediate switch, and the first bit has entered the output queue at the destination. The response times required to support MIFASS are as follows:

Category	Mean (sec)	90% less than (sec)
I	2.5	6
II	5.0	10
III	25.0	50
IV	Greater than Categories III	

Where:

Category I are messages which require the most rapid transmission because of their perishability (e.g. Shot message; or check Fire).

Category II are messages that are used to support the operational aspects of MIFASS. Typically, these messages are either automatically generated by the MIFASS software in response to a received message, or transmitted as a result of a switch action (e.g. Fire Command Message).

Category III are messages that are used to update the data base on an infrequent basis or to provide summary information at the conclusion of a mission (e.g. Fire Unit Capabilities message).

Category IV are messages that could be accommodated by current response times, which are less than category III.

It is expected that a MIFASS message will be 100 - 300 bits in length.

3.3.3 Air Defense.

This paragraph discusses the various factors in relationship to the participants operating in an Air Defense network (including both SHORAD and LORAD).

3.3.3.1 Geographical Relationships. Figures 3.3.3.1-1 (corps area of operation), 3.3.3.1-2 (center Division slice), and 3.3.3.1-3 (lower Brigade slice) depict typical deployment of Air Defense participants and shows the information flow paths by which air defense data is passed back and forth between participants. Although not shown in these schematics, each ROLAND battery has 9 fire units located generally in the Corps area near the Division near boundary and each fire unit interfaces with its respective ROLAND battery.

3.3.3.1.1 Identity Codes. Because of the number of participants in the Air Defense environment, identity codes were not developed. Approximate and maximum distances are based on a general analysis of the three schematics and documented by participant links in general.

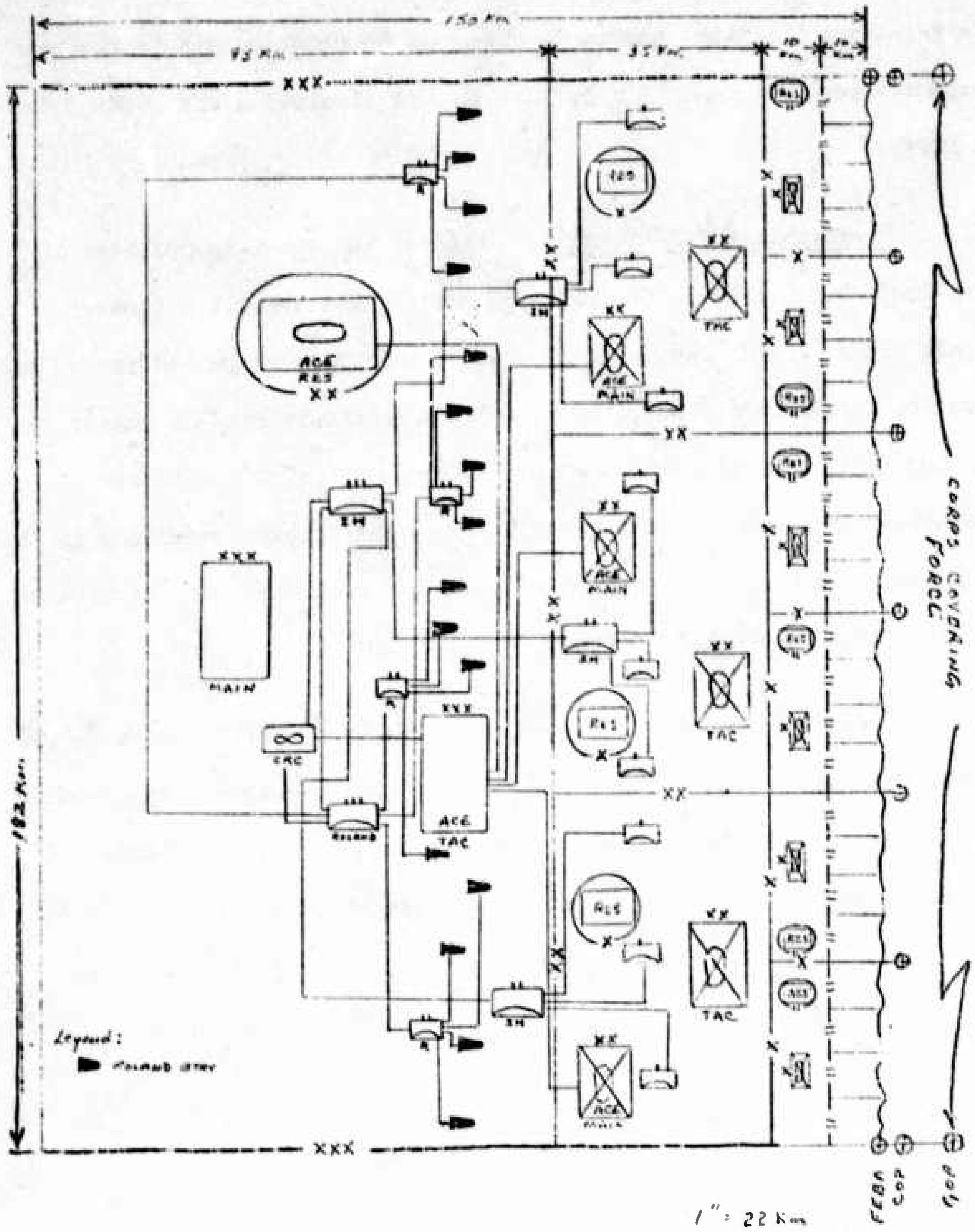

Figure 3.3.3.1-1 Type Corps Area of Operations with Air Defense Participants and Lines of Information Flow

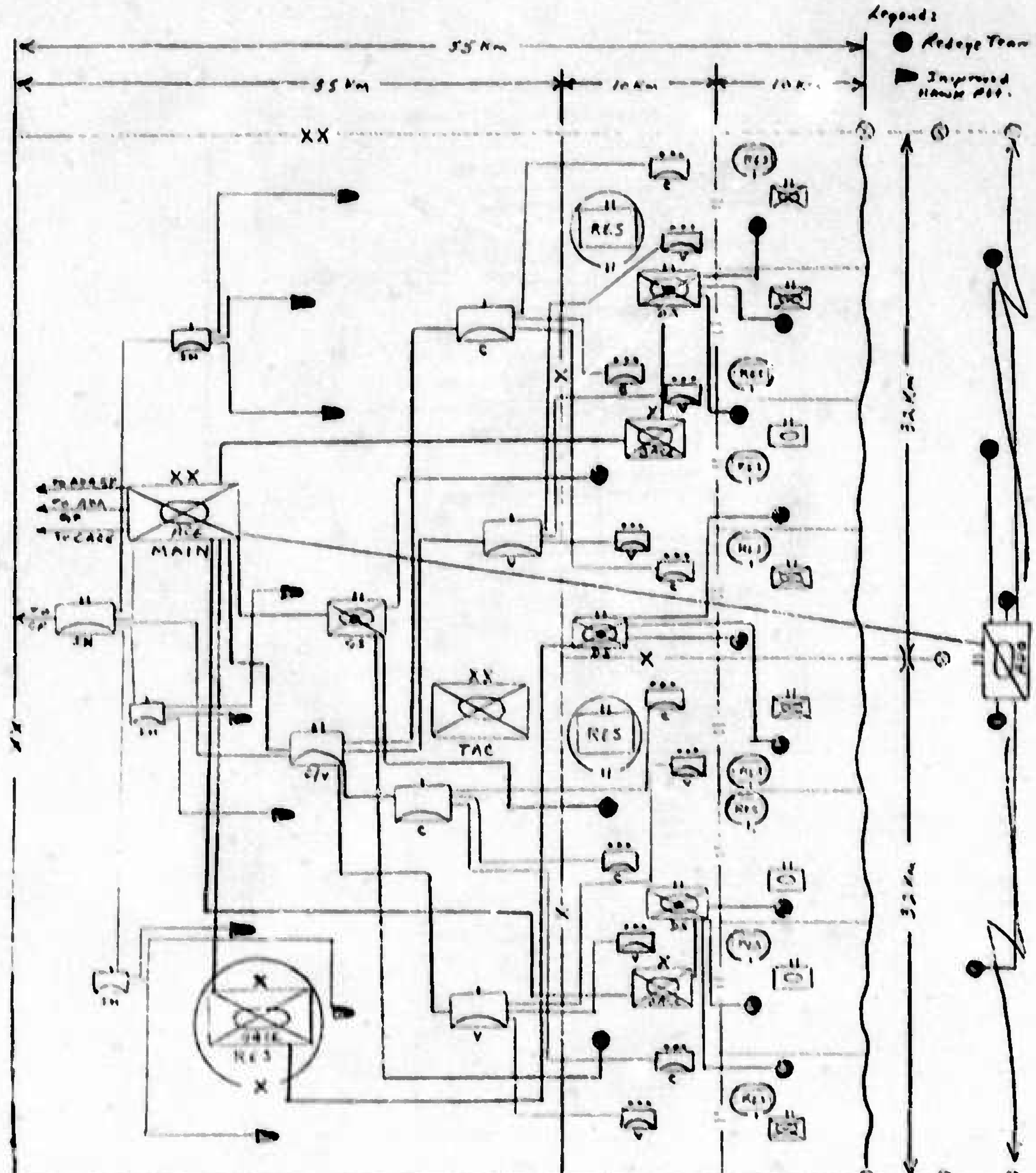

Figure 3.3.3.1-2 Type Division Area of Operations with Air Defense Participants and Lines of Information Flow

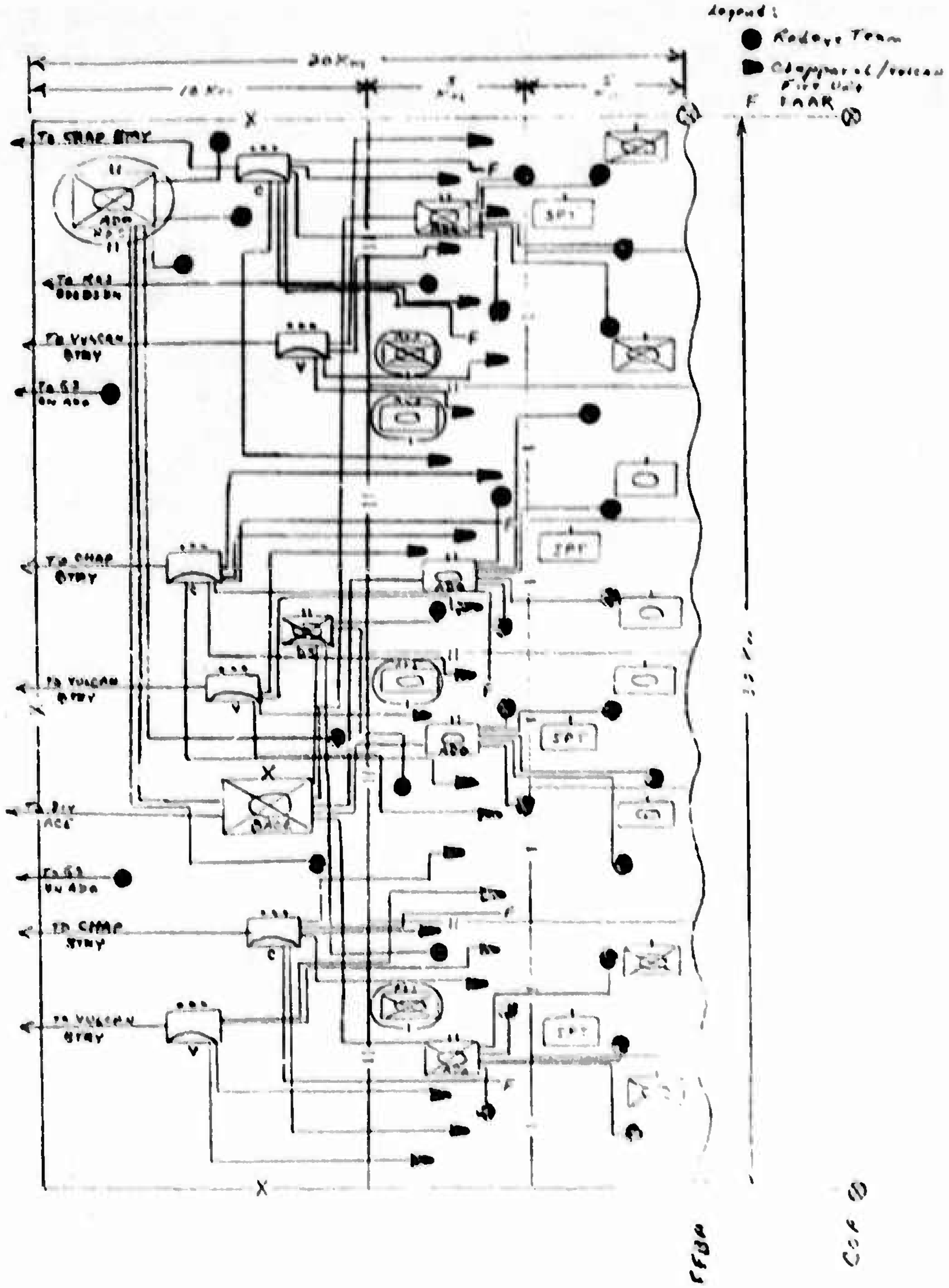

Figure 3.3.3.1-3 Type Brigade Area of Operations with Air Defense Participants and Lines of Information Flow

3.3.3.1.2 Approximate Distances. Table 3.3.3.1.2-1 depicts the approximate average distances that exist between participants in a participant link as shown on the three schematics.

3.3.3.1.3 Maximum Distances. Table 3.3.3.1.3-1 depicts the maximum distances that could exist between any set of participants. In determining these distances, consideration was given to the largest distance for any set of participants as shown by the schematics as well as what is considered the worst possible case based on knowledge from past military experience.

3.3.3.2 Connectivity. Figure 3.3.3.2-1 depicts a Corps connectivity diagram and figure 3.3.3.2-2 a Division connectivity diagram for Air Defense. They show all the various Air Defense participants with interconnecting lines denoting the method of traffic flow between participants. When used with figures 3.3.3.1-1, 3.3.3.1-2. and 3.3.3.1-3, these diagrams provide a basis for determination of where in the network relays may be required because of the distance separation of participants. The lines of connectivity are based on information flow that currently exists for Air Defense by use of tactical FM radio and multichannel equipment. To show the entire Corps area it would be necessary to have four Division connectivity diagrams with the Corps connectivity diagram.

Table 3.3.3.1.2-1 Table of Approximate Distances

Taken from Figure No.	Participant Link	Approx. Dist. (Km)
3.3.3.1-1	AF CRC - Corps ACE	33
3.3.3.1-1	AF CRC - Improved HAWK Group	44
3.3.3.1-1	AF CRC - ROLAND Group	20
3.3.3.1-1	Corps ACE - Div ACE	69
3.3.3.1-1	Improved HAWK Group - IH Bn	65
3.3.3.1-1	ROLAND Group - ROLAND Bn	50
3.3.3.1-1	ROLAND Bn - ROLAND Btry	20
3.3.3.1-1	ROLAND Btry - ROLAND FU	10
3.3.3.1-1	IH Bn - IH Btry	30
3.3.3.1-1	ROLAND Group - IH Group	57
3.3.3.1-1	Div ACE - ROLAND Group	81
3.3.3.1-1	Div ACE - IH Group	73
3.3.3.1-2	Div ACE - Bde ACE	35
3.3.3.1-2	Div ACE - ACS ADO	53
3.3.3.1-2	ACS ADO - ACS RE TM	15
3.3.3.1-2	Div ACE - GS Bn ADO	13
3.3.3.1-2	Div ACE - IH Bn	15
3.3.3.1-2	Div ACE - C/V Bn	20
3.3.3.1-2	IH Btry - IH Plt	12
3.3.3.1-2	GS Bn ADO - GS Bn AD TM	23
3.3.3.1-2	C/V Bn - IH Bn	16
3.3.3.1-2	C/V Bn - Chapparal Btry	18
3.3.3.1-2	C/V Bn - VULCAN Btry	19
3.3.3.1-2	Chapparal Btry - Chapparal Plt	17
3.3.3.1-2	VULCAN Btry - VULCAN Plt	17
3.3.3.1-2	Bde ACE - DS Bn ADO	15
3.3.3.1-2	DS Bn ADO - DS Bn AD Tm	12
3.3.3.1-3	Chapparal Plt - Chapparal FU	10
3.3.3.1-3	Chapparal Plt - FAAR	9
3.3.3.1-3	VULCAN Plt - VULCAN FU	10
3.3.3.1-3	Bde ACE - Maneuver Bn ADO	12
3.3.3.1-3	Maneuver Bn ADO - Maneuver Bn RE Tm	5

Table 3.3.3.1.3-1 Table of Maximum Distances

Participant Link	Max. Dist. (Km)
AF CRC - Corps ACE	35
AF CRC - IH Group	45
AR CRC - ROLAND Group	45
Corps ACE - Div ACE	80
IH Group - IH Bn	95
ROLAND Group - ROLAND Bn	115
ROLAND Bn - ROLAND Btry	35
ROLAND Btry - ROLAND FU	15
IH Bn - IH Btry	40
ROLAND Group - IH Group	60
Div ACE - ROLAND Group	100
Div ACE - IH Group	115
Div ACE - Bde ACE	45
Div ACE - ACS ADO	65
ACS ADO - ACS RE Tm	30
Div ACE - GS Bn ADO	20
Div ACE - IH Bn	20
Div ACE - C/V Bn	25
IH Btry - IH Plt	15
GS Bn ADO - GS Bn AD Tm	30
C/V Bn - IH Bn	20
C/V Bn - Chapparal Btry	30
C/V Bn - VULCAN Btry	30
Chapparal Btry - Chapparal Plt	20
VULCAN Btry - VULCAN Plt	20
Bde ACE - DS Bn ADO	30
DS Bn ADO - DS Bn AD Tm	15
Chapparal Plt - Chapparal FU	15
Chapparal Plt - FAAR	12
VULCAN Plt - VULCAN Fu	15
Bde ACE - Maneuver Bn ADO	20
Maneuver Bn ADO - Maneuver Bn RE Tm	20

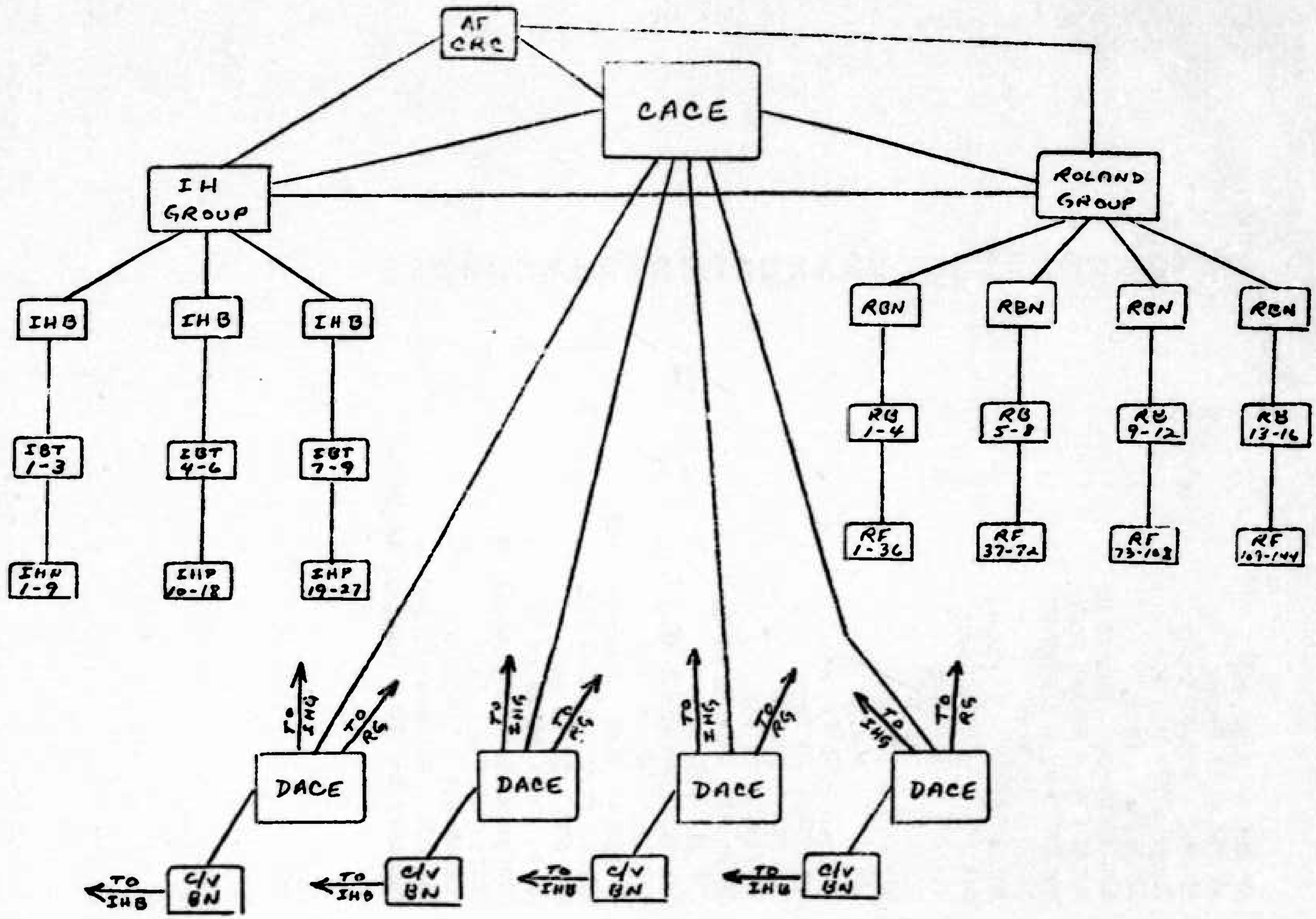

Figure 3.3.3.2-1 Corps Air Defense Connectivity Diagram

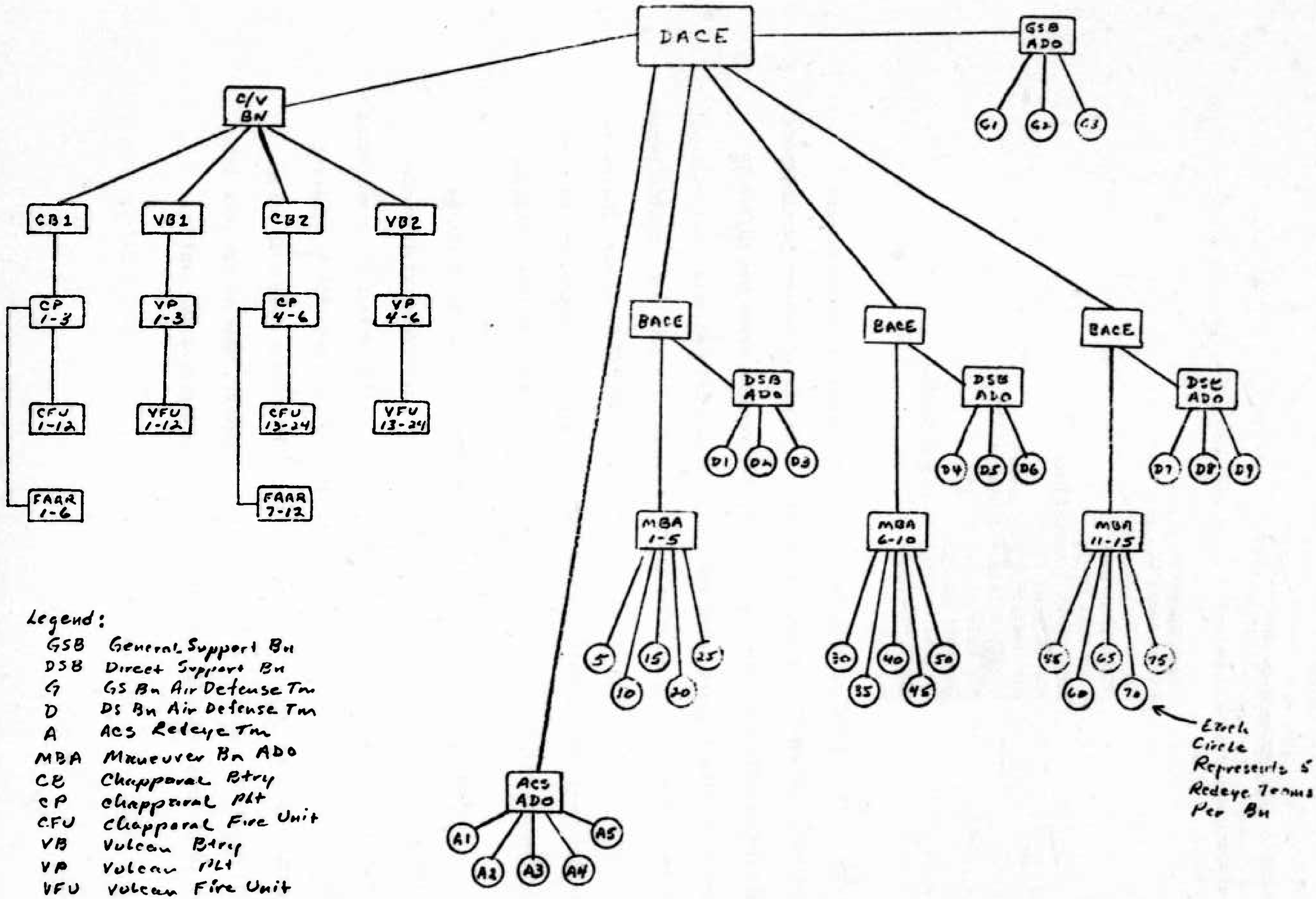

Figure 3.3.3.2-2 Division Air Defense Connectivity Diagram

3.3.3.3 <u>Information Types</u>. Some of the types of data that flow between participants operating in an Air Defense environment are as follows:

- Track Identification
- Air Defense Warning
- Track Position Data
- Employment Results
- Fire Unit Status
- Employment Instructions
- Air Defense Plans
- Air Defense Intelligence
- Location Data and Status
- Air Defense Priorities
- Post Attack Data
- Weapons Control Data and Status
- Air Threat Data
- Weather

Since in the SHORAD environment the primary means of communications presently is voice, the quantity of data transmitted between participants is considerably less than in the LORAD environment where the AN/TSQ-73 system is used to pass large quantities of air defense data. Although all of the information types given above essentially apply to all participants, the forward air defense elements, such as the REDEYE teams are limited as to what they can transmit and receive. In this environment, air defense warning and air defense intelligence information become very critical.

3.3.3.4 <u>Traffic Flow</u>. Within a given tactical situation, it can be expected that a certain volume of data will pass between participants. For a forward area air defense element (e.g. REDEYE team), it is estimated that 200 messages will be transmitted and 120 messages will be received during a 24 hour period. It can be expected that the peak hour volume will be about 10% of the 24 hour volume. However, when we get back into the LORAD area where we are dealing with the Improved HAWK and its

supporting AN/TSQ-73, it is estimated that the 24 hour volume for a IH Battalion will be 3+ million messages transmitted and 3+ million messages received. It is expected that the peak hour volume will be about 4% of the 24 hour volume. Along with this must be considered the fact that the message lengths are considerably shorter for the IH Battalion as compared to the REDEYE team.

3.3.3.5 Timing Requirements. Timing is based on the length of messages to be transmitted and received. It is estimated that a message from or to a REDEYE team will be a verbal transmission with a 15-20 seconds duration and that the required access time to output a message by a REDEYE team would be on the order of 30 seconds. Conversely, it is estimated that a message from or to an IH Battalion will be a data transmission with a length of 76-98 bits and that the required access time to output a message by the IH Battalion would be on the order of less than one second. This access time is critical because of the rapid update required to keep track information current.

3.3.4 Close Air Support

This paragraph discusses the various factors in relationship to the participants operating in a Close Air Support Network (including the AF Air Request Net and Helicopter Nap of the Earth operations).

3.3.4.1 Geographical Relationships. Figures 3.3.4.1-1 (corps area of operations), 3.3.4.1-2 (center Division slice), and 3.3.4.1-3 (lower Brigade slice) depict typical deployment of Close Air Support participants and shows the information flow paths by which close air support data is passed back and forth between participants. These schematics do not show the information flow paths between tactical AF aircraft and ground AF elements such as the GFAC to/from tactical AF aircraft. In addition, attack and observation helicopters of the Attack Helicopter Battalion, Assault Helicopter Battalion, Armored Cavalry Regiment Air Cavalry Troop, and the Armored Cavalry Squadron Air Cavalry Troop do not show on these schematics but would exchange information with their respective headquarters and should possess the capability to interface with the ground elements. These helicopters will be operating in close proximity to the FEBA with attack and assault helicopters operating well forward of the FEBA. All TACPs at various echelons are collocated with the ground echelon headquarters as the DASC is collocated with the Corps TASE.

3.3.4.1.1 Identity Codes. Identity codes were not developed for the participants in the Close Air Support environment. Approximate and maximum distances are based on a general analysis of the three schematics and documented by participant links in general.

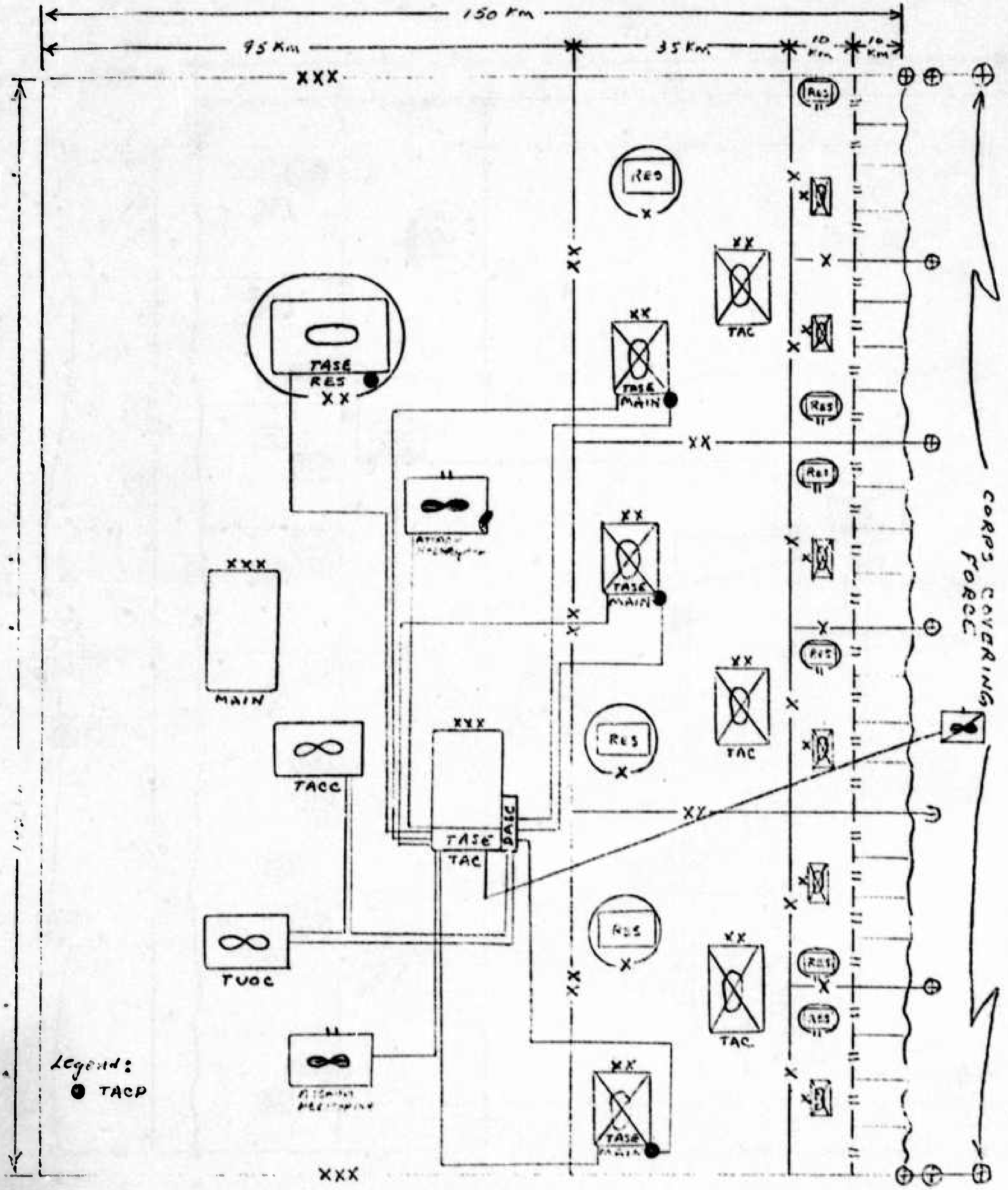

Figure 3.3.4.1-1 Type Corps Area of Operations with Close Air Support participants and Lines of Information Flow

1" = 22 Km

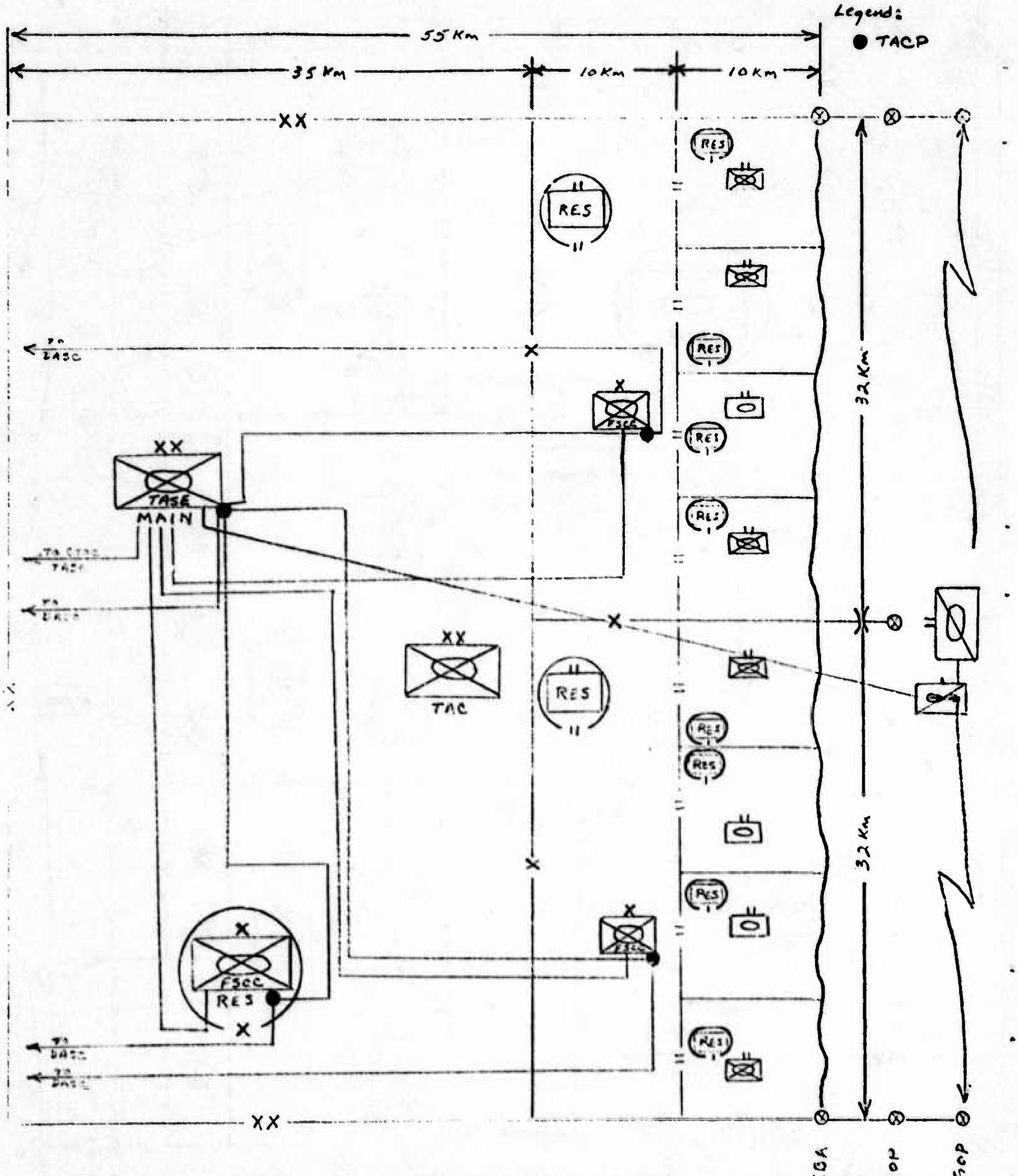

Figure 3.3.4.1-2 Type Division Area of Operations with Close Air Support participants and Lines of Information Flow 1 = 5 Km

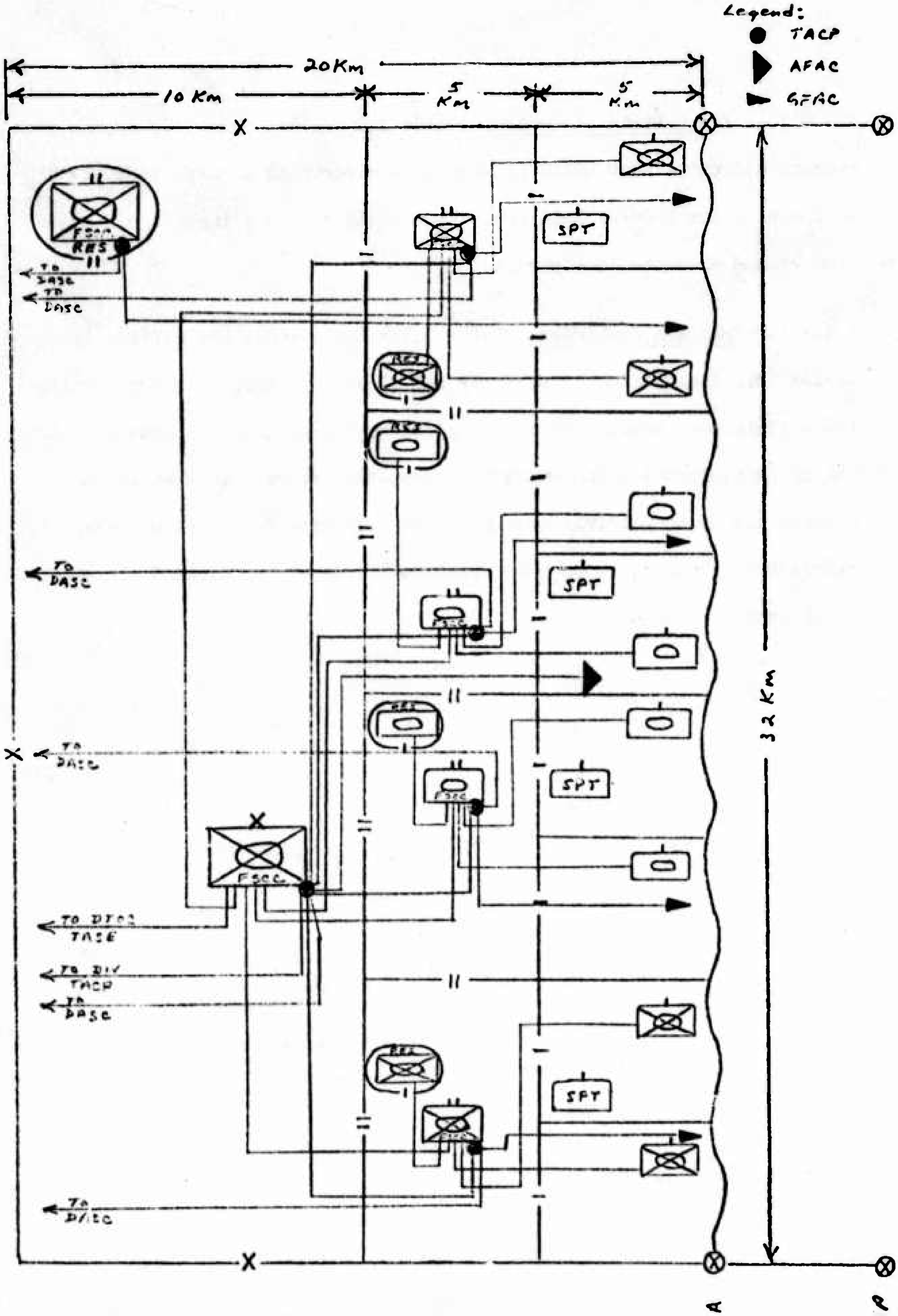

Figure 3.3.4.1-3 Type Brigade Area of Operations with Close Air Support participants and Lines of Information Flow

1" = 4 Km

3.3.4.1.2 Approximate Distances. Table 3.3.4.1.2-1 shows the approximate average distances that exist between participants in a participant link as shown on the three schematics. This table does not include distances from ground elements to aircraft.

3.3.4.1.3 Maximum Distances. Table 3.3.4.1.3-1 shows the maximum distances that could exist between any set of participants. In determining these distances, consideration was given to the largest distance for any set of participants as shown by the schematics as well as what is considered the worst possible case based on knowledge from past military experience. This table does not include distances from ground elements to aircraft.

Table 3.3.4.1.2-1 Table of Approximate Distances

Taken from Figure No.	Participant Link	Approx. Dist. (Km)
3.3.4.1-1	TACC - DASC	37
3.3.4.1-1	TUOC - DASC	51
3.3.4.1-1	TUOC - TACC	35
3.3.4.1-1	Corps TASE - Atk. Hel. Bn	50
3.3.4.1-1	Corps TASE - Assault Hel. Bn	55
3.3.4.1-1	Corps TASE - ACR Air Cav Tp	88
3.3.4.1-1	Corps TASE - Div TASE	60
3.3.4.1-1	DASC - Div TACP	60
3.3.4.1-1	DASC - Bde TACP	85
3.3.4.1-1	DASC - Bn TACP	100
3.3.4.1-2	Div TASE - Bde FSCC	35
3.3.4.1-2	Div TACP - Bde TACP	35
3.3.4.1-2	Div TASE - ACS Air Cav Tp	51
3.3.4.1-3	Bde FSCC - Bn FSCC	12
3.3.4.1-3	Bde TACP - Bn TACP	12
3.3.4.1-3	Bde TACP - AFAC	12
3.3.4.1-3	Bn FSCC - Co Comdr	5
3.3.4.1-3	Bn TACP - GFAC	7

Table 3.3.4.1.3-1 Table of Maximum Distances

Participant Link	Max. Dist. (Km)
TACC - DASC	55
TUOC - DASC	55
TUOC - TACC	40
Corps TASE - Atk. Hel. Bn	55
Corps TASE - Assault Hel. Bn	55
Corps TASE - ACR Air Cav Tp	100
Corps TASE - DIV TASE	75
DASC - Div TACP	75
DASC - Bde TACP	125
DASC - Bn TACP	140
Div TASE - Bde FSCC	45
Div TACP - Bde TACP	45
Div TASE - ACS Air Cav Tp	55
Bde FSCC- Bn FSCC	20
Bde TACP - Bn TACP	20
Bde TACP - AFAC	20
Bn FSCC - Co Comdr	8
Bn TACP - GFAC	10

3.3.4.2 Connectivity. Figure 3.3.4.2-1 depicts a Corps Close Air Support connectivity Diagram. It is not possible to show all the aircraft that could be involved but the diagram does indicate some of the points of interface with the aircraft. Not all the points of interface with the aircraft are shown on this diagram. The aircraft should possess the capability of interfacing with any of the ground elements. With the new concept of the FO assumming the same responsibilities as the GFAC, the GFAC on this diagram can be assumed to represent the FO as well although there would be considerably more than shown and they would then interface with the battalion FSCC as well as the battalion TACP. When used with figures 3.3.4.1-1, 3.3.4.1-2, and 3.3.4.1-3, these diagrams provide a basis for determination of where in the network relays may be required because of the distance separation of participants. The lines of connectivity are based on information flow that currently exists for Close Air Support by use of tactical FM radio equipment and to some extent multichannel capability between brigades and divisions and divisions and corps.

3.3.4.3 Information Types. Some of the types of data that flow between participants operating in the close air support environment are as follows:

Request for immediate close air support

Request for preplanned close air support

Air Fire plans

Assignment priorities

Approval/disapproval of requests

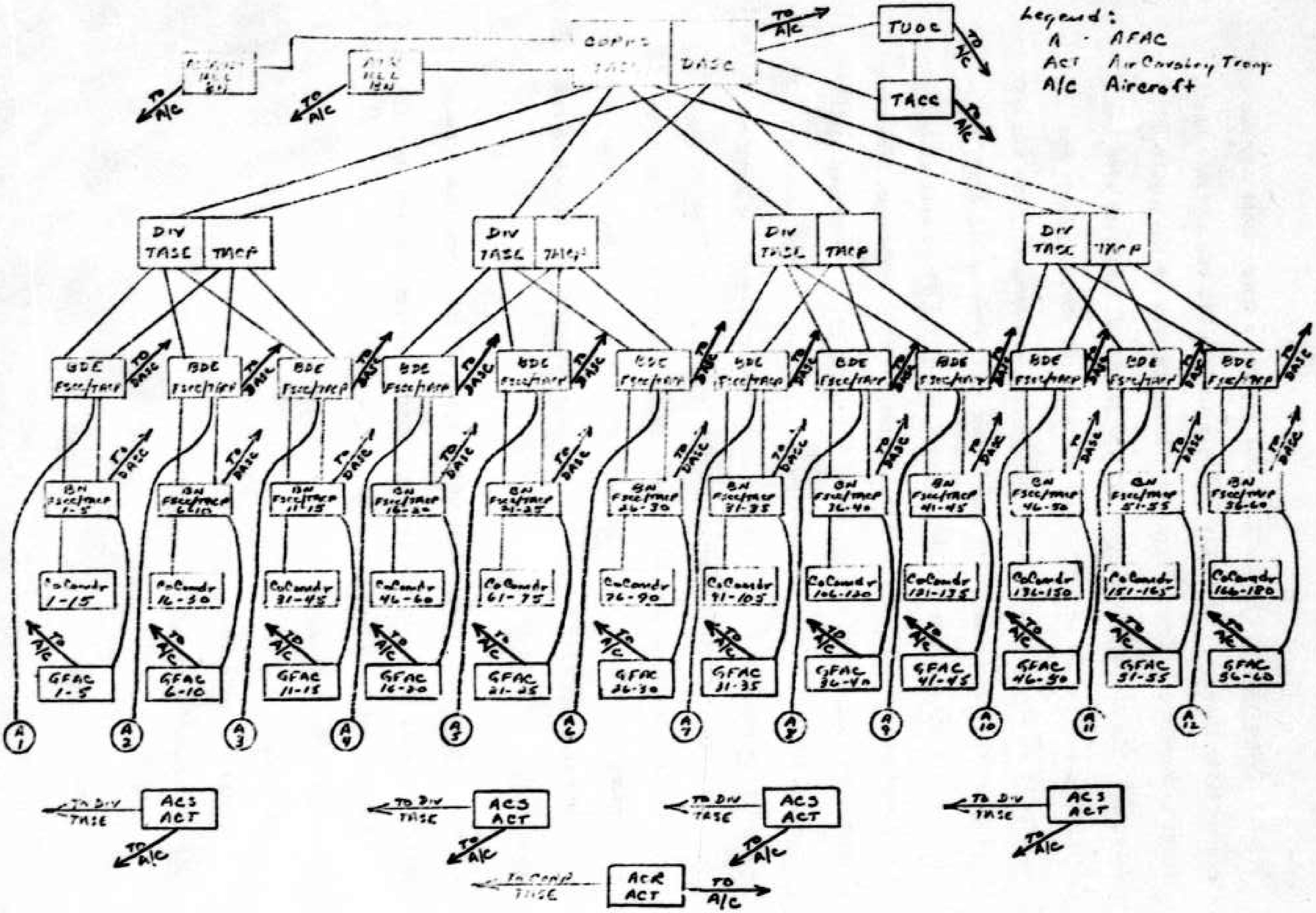

Figure 3.3.4.2-1 Corps Close Air Support Connectivity Diagram

Close air support coordination

Request for immediate armed helicopter fire support

Request for preplanned armed helicopter fire support

Armed helicopter fire support plans

Flight coordination

Direction to target coordination

Aircraft hazards information

Location data

Currently, in the close air support environment, all information is transmitted via voice communications. However, the development of AF data systems may lead to automation of this transfer of information in the future.

3.3.4.4 Traffic Flow. Within the close air support environment, it can be expected that a certain volume of data will pass between participants. For a forward close air support element (e.g. the GFAC), it is estimated that 200 messages will be transmitted and 200 messages will be received during a 24 hour period. It can be expected that the peak hour volume will be about 15% of the 24 hour volume. When we get back into the areas removed from the forward area (e.g. a battalion TACP), it is estimated that the 24 hour volume will be about 440 messages transmitted and a like number received. It is expected that the peak hour volume will be about 10% of the 24 hour volume.

3.3.4.5 Timing Requirements. Timing is based on the length of messages to be transmitted and received. It is estimated that a message in the close air support environment will average about 20 to 30 seconds. There will be some messages of very short duration (e.g. when a GFAC is directing the aircraft flight to the target) and others of longer duration (e.g. the transmission of air fire plans at higher level echelons). It is estimated that the required access time (time to access the network) should be about 1 second for a FAC but about 30 seconds by the battalion TACP or other higher echelon elements.

3.3.5 Forward Airspace Management This paragraph discusses the various factors in relationship to the participants operating in a forward airspace management network.

Airspace over the forward elements of an Army Division is shared by many diverse agencies each with their own command and control system. The Marines have attempted to automate the management of their airspace through the use of MIFASS. The Army, because of the difference in structure, however, has evolved several independent parallel control systems. TACFIRE controls the artillery fires, TOS will provide automated command and control for maneuver units, AN/TSQ-73 and DIVADS will control air defense units, and the Air Force controls TACAIR elements operating in support of the Army.

Coordination of airspace in the Division is the responsibility of the commanders at each echelon. If a battalion commander wants air support, he must ensure that artillery fires in his area are coordinated to provide adequate clearance for the tactical aircraft. He must also ensure that air defense fires are coordinated to protect the friendly aircraft and that Army aircraft operations do not interfere. Since the air support will probably require access to airspace of other units as well, the brigade and division commanders and staff are also involved.

Presently, no automation is provided in support of this task. An attempt was made at one time to develop a system known as the Air Traffic Management and Control (ATMAC) System. Development was halted on ATMAC for various

reasons, however, one of the most pressing difficulties the system faced was a means of obtaining real time data on aircraft, artillery, air defense weapons and other users of airspace.

Aircraft that show up on radar, and air defense weapons under automated real time control did not pose much of a problem, however, SHORAD weapons and Army helicopters flying nap-of-the-earth missions presented a problem in terms of real time position and status data capture.

JTIDS Class 3 terminals offer the answer to much of the data collection and information dissemination problem. For example:

- JTIDS terminals at each artillery battery, interfaced with the Battery Computer System (BCS) would broadcast data on fire missions.
- Air Defense elements would broadcast messages indicating restricted areas and danger zones as well as hostile aircraft information.
- Sensors such as the Stand-off Target Acquisition System (SOTAS) would broadcast locations of suspected enemy SAM sites.
- Air Space Control elements at Division (DACE) and Brigade (BACE) would broadcast coordination and control measures.
- Aircraft would broadcast their location, velocity and status.
- Interfaces with PLRS and TOS would allow Aircraft to query for the location of friendly units.
- Range and bearing to specific locations could be provided and pilots could also request safe courses to specific destinations from a ground based processor.

Ground control elements such as the DACE, the BACE, TACPs, and FACs would also have access to the information in this net for planning, coordination and control purposes. In general, the net would be structured to provide pilots with a composite airspace situation picture in the Division area. Graphics presentation of this data would be desirable in the cockpit along with audible alert for imminent hazards.

3.3.5.1 Geographical Relationships. Figures 3.3.5.1-1 (Division area of operation) and 3.3.5.1-2 (Lower Brigade slice) depict typical deployment of airspace management participants and shows the information flow paths by which airspace management data is passed back and forth between participants. Although not shown in these schematics, all participants should possess the capability of interfacing with the Air Force and Army tactical aircraft.

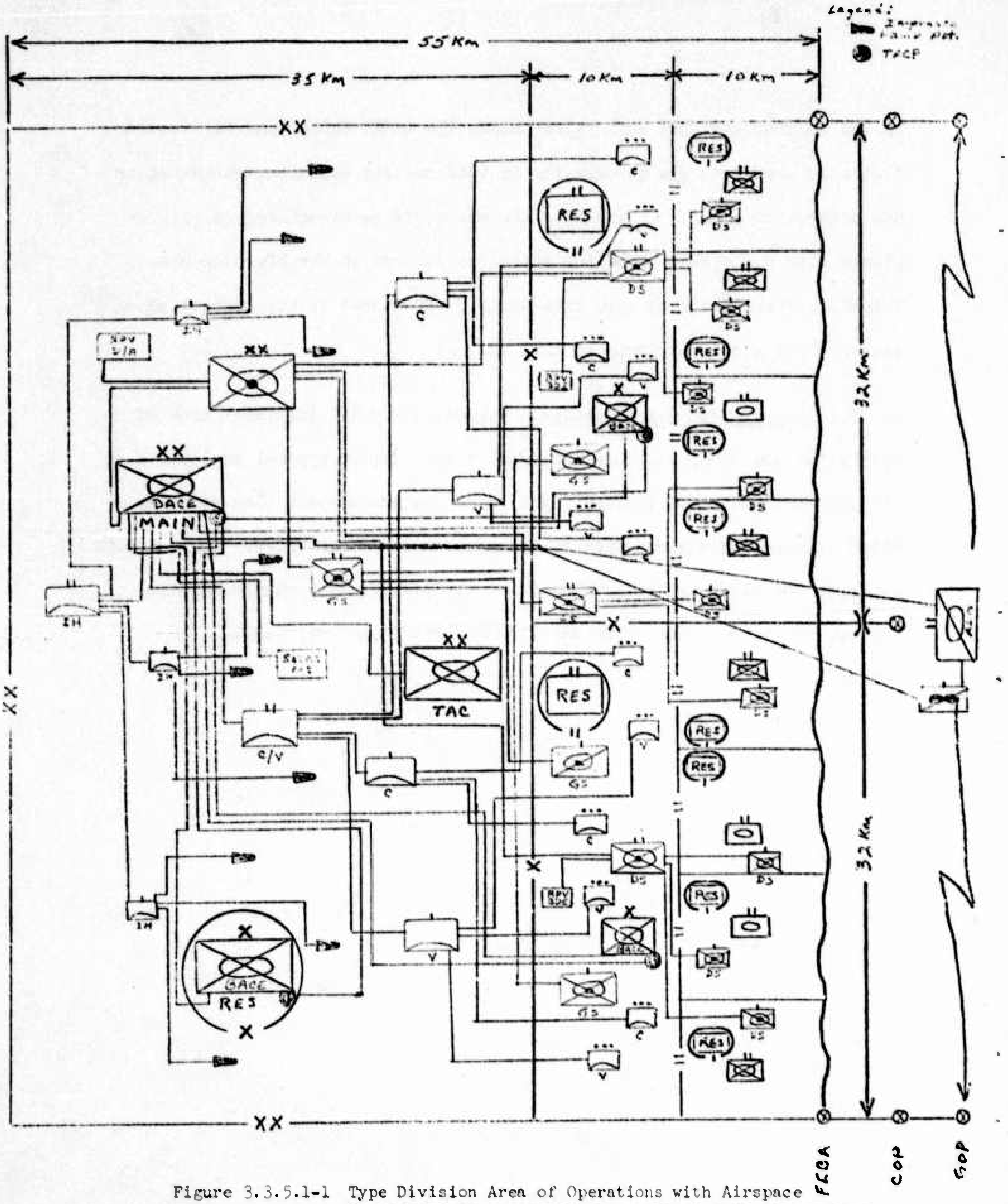

Figure 3.3.5.1-1 Type Division Area of Operations with Airspace Management Participants and Lines of Information Flow

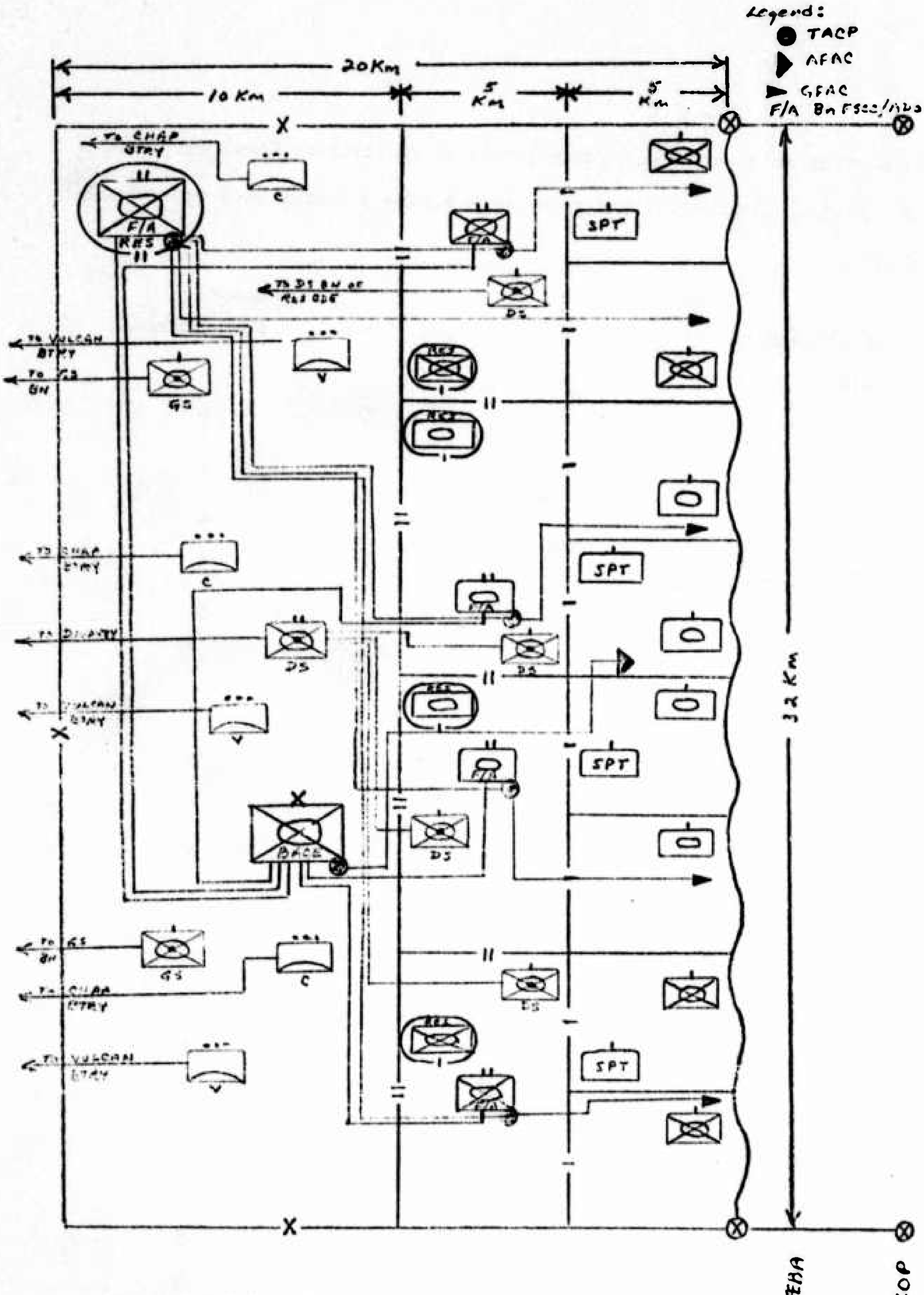

Figure 3.3.5.1-2 Type Brigade Area of Operations with Airspace Management Participants and Lines of Information Flow

The participants that would interoperate in an Airspace Managment Network for a Division with three Brigades (each having 5 battalions) would be as follows:

Participants	Quantity per Division
DACE	1
DIV TAC	1
DIVARTY	1
IH Bn	1
IH Btry	3
IH PLt	9
C/V Bn	1
Chapparal Btry	2
Chapparal PLt	6
VULCAN Btry	2
VULCAN PLt	6
ACS ADO	1
ACS Air Cav Tp	1
SOTAS DIV MS	1
RPV DIVARTY	1
TACP (DIV)	1
GS Bn	1
GS Btry	3
DS Bn	3
DS Btry	9

RPV (Bde)	3
BACE	3
TACP (Bde)	3
Maneuver Bn FSCC/ADO	15
TACP (Bn)	15
GFAC	15
AFAC	3

3.3.5.1.1 Identity Codes. Identity codes were not developed for the participants in the Airspace Management environment. Approximate and maximum distances are based on a general analysis of the two schematics and documented by participants links in general.

3.3.5.1.2 Approximate Distances. Table 3.3.5.1.2-1 shows the approximate average distances that exist between participants in a participant link as shown on the two schematics. This table does not include distances from ground elements to aircraft.

3.3.5.1.3. Maximum Distances. Table 3.3.5.1.3-1 shows the maximum distances that could exist between any set of participants. In determining these distances, consideration was given to the largest distance for any set of participants as shown by the schematics as well as what is considered the worst possible case based on knowledge from past military experience. This table does not include distances from ground elements to aircraft.

Table 3.3.5.1.2-1 Table of Approximate Distances

Taken from Figure No.	Participant Link	Approx. Dist. (Km)
3.3.5.1-1	DACE - BACE	60
3.3.5.1-1	DACE - DIV TAC	22
3.3.5.1-1	DACE - DIVARTY	10
3.3.5.1-1	DACE - SOTAS MS	15
3.3.5.1-1	DACE - C/V Bn	20
3.3.5.1-1	DACE - IH Bn	15
3.3.5.1-1	DACE - ACS ADO	53
3.3.5.1-1	DACE - ACS Air Cav Tp	53
3.3.5.1-1	ACS ADO- ACS Air Cav Tp	15
3.3.5.1-1	DIVARTY - GS Bn	12
3.3.5.1-1	DIVARTY - DS Bn	30
3.3.5.1-1	DIVARTY - RPV DIVARTY	8
3.3.5.1-1	TACP (DIV) - TACP (Bde)	35
3.3.5.1-1	IH Bn - IH Btry	30
3.3.5.1-1	IH Btry - IH PLt	12
3.3.5.1-1	C/V Bn - Chapparal Btry	18
3.3.5.1-1	C/V Bn - VULCAN Btry	19
3.3.5.1-1	Chapparal Btry - Chapparal PLt	17
3.3.5.1-1	VULCAN Btry - VULCAN PLt	17
3.3.5.1-1	GS Bn - GS Btry	24
3.3.5.1-1	DS Bn - DS Btry	9

Table 3.3.5.1.2-1 Table of Approximate Distances (Cont'd)

Taken from Figure No.	Participant Link	Approx. Dist. (Km)
3.3.5.1-2	BACE - Bn FSCC/ADO	12
3.3.5.1-2	TACP (Bde) - TACP (BN)	12
3.3.5.1-2	TACP (Bde) - AFAC	12
3.3.5.1-2	TACP (Bn) - GFAC	7

Table 3.3.5.1.3-1 Table of Maximum Distances

Participant Link	Max. Dist. (Km)
DACE - BACE	75
DACE - DIV TAC	25
DACE - DIVARTY	40
DACE - SOTAS MS	15
DACE - C/V Bn	25
DACE - IH Bn	20
DACE - ACS ADO	65
DACE - ACS Air Cav Tp	65
ACS ADO - ACS Air Cav. Tp	20
DIVARTY - GS Bn	20
DIVARTY - DS Bn	40
DIVARTY - RPV DIVARTY	20
TACP (DIV) - TACP (Bde)	45
IH Bn - IH Btry	40
IH Btry - IH PLt	15
C/V Bn - Chapparal Btry	30
C/V Bn - VULCAN Btry	30
Chapparal Btry - Chapparal PLt	20
VULCAN Btry - VULCAN PLt	20
GS Bn - GS Btry	35
DS Bn - DS Btry	15
BACE - Bn FSCC/ADO	20

Table 3.3.5.1.3-1 Table of Maximum Distances (Cont'd)

Participant Link	Max. Dist. (Km)
TACP (Bde) - TACP (Bn)	20
TACP (Bde) - AFAC	20
TACP (Bn) - GFAC	10

3.3.5.2 Connectivity. Figure 3.3.5.2-1 depicts a Division Airspace Management Connectivity Diagram. It is not possible to show all the aircraft that could be involved but the diagram does indicate some of the points of interface with the aircraft. Not all the points of interface with the aircraft are shown on this diagram. All ground terminals should possess the capability of interfacing with any aircraft. When used with figures 3.3.5.1-1 and 3.3.5.1-2, these diagrams provide a basis for determination of where in the network relays may be required because of distance separation of participants. The lines of connectivity are based on information flow that currently exists for Airspace Management by use of tactical FM radio and multichannel facilities.

3.3.5.3 Information Types. Some of the types of data that flow between participants operating in the airspace management environment are as follows:

Data on fire missions

Restricted area and danger zones to aircraft

Hostile aircraft information

Location of suspected enemy missile sites

Coordination and control measures

Aircraft locations, velocity, and status

Location of friendly units

Situation intelligence

Range and bearing to locations

Safe air corridor information

Position and status information

Plans, coordination, and control

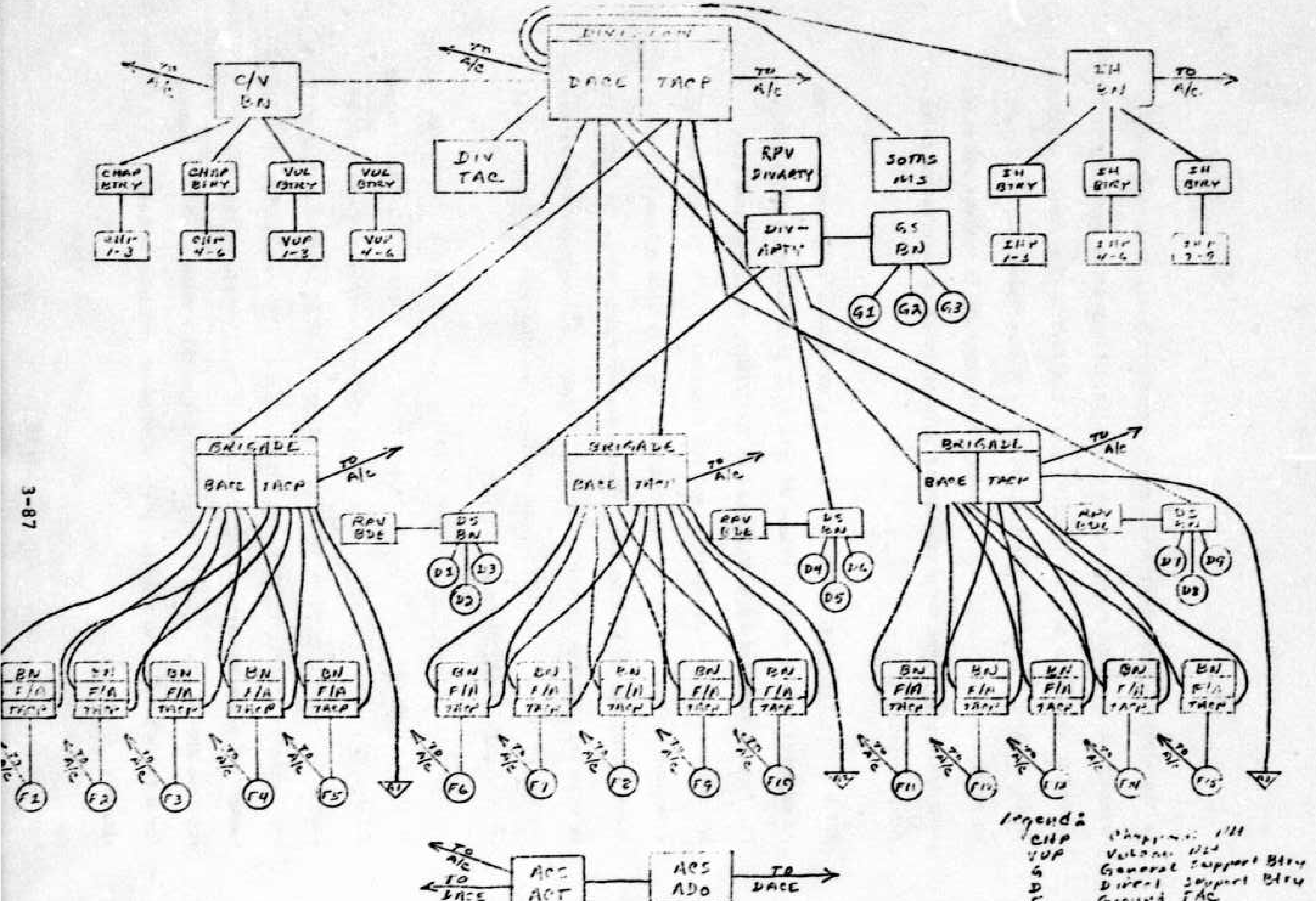

Figure 3.3.5.2-1 Division Airspace Management Connectivity Diagram

In the airspace management environment, essentially all data would be transmitted by voice except in the case of artillery units where the TACFIRE system is available and the IH units where the AN/TSQ-73 system is available. In these cases, data could be transmitted if the recipient has the capability to receive such automated data. Later development of AF systems and other Army systems may lead to automation of this transfer of information in the future similar to ATMAC.

3.3.5.4 Traffic Flow. Within the airspace management environment, it can be expected that a certain volume of data will pass between participants. For forward elements (e.g. FAC's and Bn FSCC/ADO), it is expected that 100 messages will be transmitted and 100 messages will be received during a 24 hour period. It can be expected that the peak hour volume will be about 10% of the 24 hour volume. At the rear elements (e.g. the DACE), it is expected that the 24 hour volume will be about 300 messages transmitted and a like number received. It is expected that the peak hour volume will be about 10% of the 24 hour volume.

3.3.5.5 Timing Requirements. Timing is based on the length of messages to be transmitted and received. It is estimated that a message in the airspace management environment will average about 20 to 30 seconds. There will be some messages of very short duration (e.g. when a GFAC is coordinating with the aircraft) and others of longer duration (e.g. the transmission of airspace management plans at higher level echelons). It is estimated that the required access time (time to access the networks) should be about 1 second for a FAC but about 30 seconds by the DACE on other higher echelons elements.

3.3.6 Battlefield Intelligence Collection and Dissemination. This paragraph discusses the various factors in relationship to the participants operating in a battlefield intelligence collection and dissemination environment. The participants in this network would be a combination of the participants in the Land Combat/Tactical Operations System (TOS) mission profile and the Air Reconnaissance/Surveillance/Intelligence Gathering and Dissemination mission profile, plus those ground and air sensors and their associated data systems, that provide essential raw data to the intelligence collection effort. These ground and air sensors would include such systems as the Stand-off Target Acquisition System (SOTAS), Remotely Piloted Vehicle (RPV), Position and Reporting System (PLRS) and Remotely Monitored Battlefield Sensor System (REMBASS). In addition, intelligence data will be derived from other tactical data systems such as the Tactical Fire Direction System (TACFIRE), Missile Minder (AN/TSQ-73), Army Terrain Information System (ARTINS), Mobile Army Ground Imagery Interpretation Center (MAGIIC), Tactical Control and Analysis System (TCAS), and the Automatic Meteorological System (AMS). The participants in this net would not only be the collectors of intelligence and users of intelligence, but also intelligence analysts. This net would serve to make raw intelligence immediately available to those elements who can use it, to get the raw intelligence to the analysis facilities where it can be processed and collated with other sources, and finally, provide a means for dissemination of finished intelligence to all users.

3.3.6.1 Geographical Relationships. Figures 3.3.6.1-1 (Corps area of Operation), 3.3.6.1-2 (Center Division Slice), and 3.3.6.1-3 (Lower Brigade Slice) depict typical development of battlefield intelligence collection and dissemination participants and shows the information flow paths by which intelligence data is passed back and forth between participants. These schematics do not show the aircraft or information flow paths between aircraft of the CEWI units and Air Cavalry Troops, which are used for gathering intelligence, and the ground elements. These aircraft would exchange data with their respective headquarters and other ground elements. Some of the participants (E.g. CTOC/EWIOC, CTOC/INTEL element, CTOC/Operations element, and CTOC/BCC) are collocated and appear only once on the schematic but separate Class 3 Terminals may be desirable. Tables 1.2.10-1 and 1.2.16-1 show some of the participants that would operate in the intelligence collection and dissemination effort. To the participants listed in these two tables must be added SOTAS, RPV, PLRS, and REMBASS which provide ground and air sensor intelligence information. Intelligence data interchanged with tactical data systems such as TACFIRE, AN/TSQ-73, ARTINS, MAGIIC, TCAS, and AMS are represented on the schematics by flow lines from the particular element headquarters utilizing the tactical data system (i.e., DivArty for TACFIRE, IH Group for AN/TSQ-73, Engineer Brigade for ARTINS, CEWI Groups for MAGIIC, and the CEWI Group and CEWI Bn for TCAS). For this scenario, the separate brigade, with its 5 manuever battalions, assigned to Corps, is uncommitted and held in reserve. It is depicted only as the brigade. The brigade headquarters and each of its battalion

headquarters must possess Class 3 Terminal capability to operate when committed and during the time they are in reserve. The CTOC depicted in the schematic includes the TASE, EWIOC, Intelligence Element, Operations Element, Weather Element, and the BCC. Each DTOC depicted includes the TASE, EWIOC, Intelligence Element, Weather Element, and the Operations Element. The Air Cavalry Troop is part of the ACS both at Corps and Division level and is not depicted separately on the schematic. In addition, there is a separate Air Cavalry Troop directly under the ACR and is shown. The AEROSCOUT platoon and its aircraft are part of the Air Cavalry Troop and not depicted separately on the schematics.

3.3.6.1.1 Identity Codes. Identity Codes were not developed for the participants in intelligence gathering and dissemination. Approximate and maximum distance are based on a general analysis of the three schematics and documented by participant link in general.

3.3.6.1.2 Approximate Distances. Table 3.3.6.1.2-1 shows the approximate average distances that exist between participants in a participant link as shown on the three schematics. This table does not include distances from ground elements to aircraft.

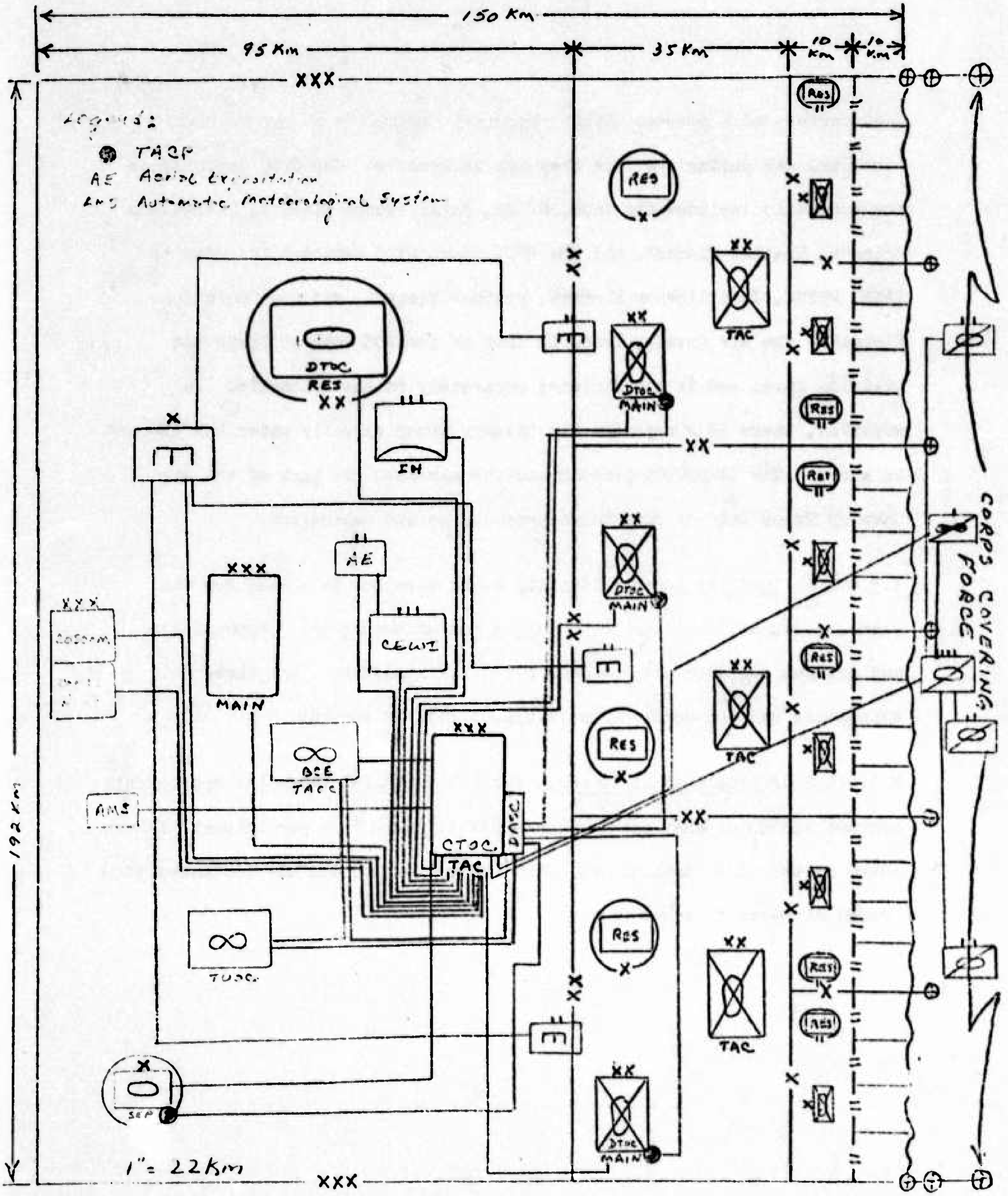

Figure 3.3.6.1-1 Type Corps Area of Operations with Intelligence Collection and Dissemination Participants and Lines of Information Flow

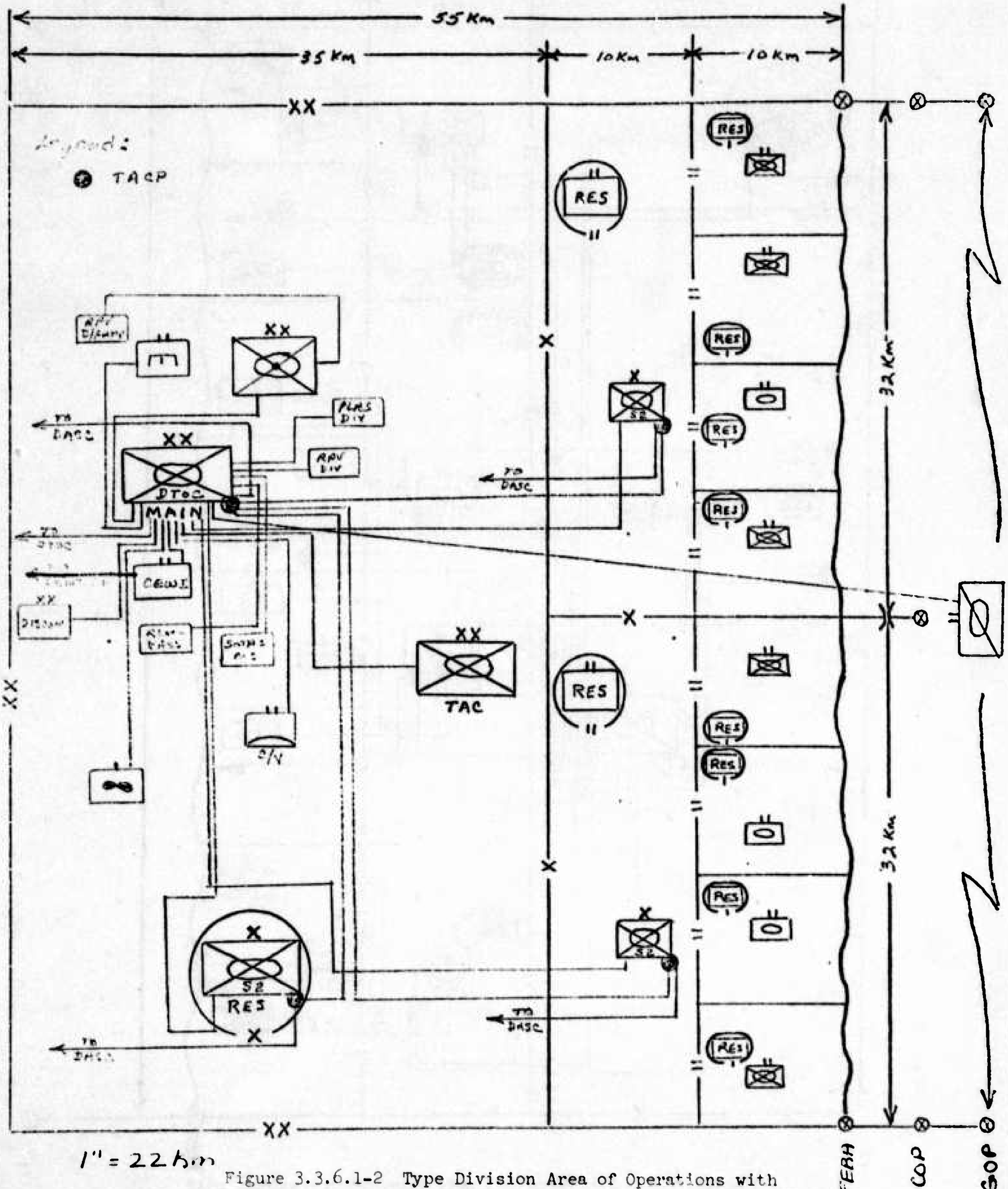

Figure 3.3.6.1-2 Type Division Area of Operations with Intelligence Collection and Dissemination Participants and Lines of Information Flow

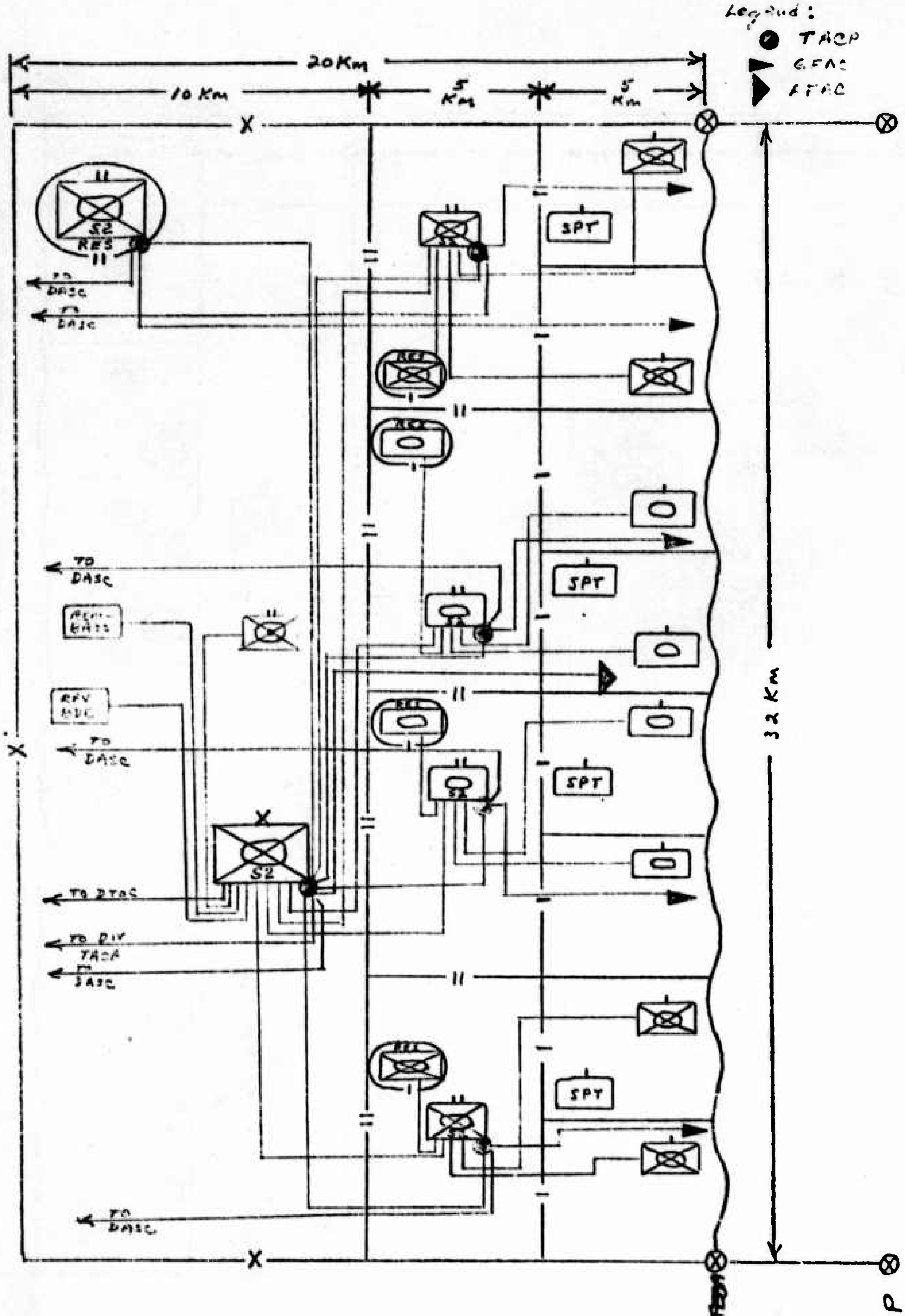

Figure 3.3.6.1-3 Type Brigade Area of Operations with Intelligence Collection and Dissemination Participants and Lines of Information Flow

Table 3.3.6.1.2-1 Table of Approximate Distances

Taken from Figure No.	Participant Link	Approximate Distance (km)
3.3.6.1-1	CTOC - DTOC	60
3.3.6.1-1	CTOC - ACR	85
3.3.6.1-1	CTOC - Air Cav Tp	88
3.3.6.1-1	CTOC - IH Gp (AN/TSQ-73)	66
3.3.6.1-1	CTOC - CEWI Gp (MAGIIC, TCAS)	28
3.3.6.1-1	CTOC - AE Bn	44
3.3.6.1-1	CTOC - Engr Bde (ARTINS)	77
3.3.6.1-1	CTOC - Corp Main	50
3.3.6.1-1	CTOC - COSCOM	77
3.3.6.1-1	CTOC - Corps Rear	77
3.3.6.1-1	CTOC - Separate Bde	77
3.3.6.1-1	CTOC - TACC	30
3.3.6.1-1	CTOC - AMS	65
3.3.6.1-1	DASC - TUOC	51
3.3.6.1-1	DASC - TACC	37
3.3.6.1-1	TACC - TUOC	35
3.3.6.1-1	DASC - TACP (Div)	60
3.3.6.1-1	DASC - TACP (Bde)	85
3.3.6.1-1	DASC - TACP (Bn)	100
3.3.6.1-1	Engr Bde - Engr Bn	95
3.3.6.1-1	CEWI Gp - CEWI Bn	55
3.3.6.1-1	CEWI Gp - AE Bn	18

Table 3.3.6.1.2-1 (continued)

Taken from Figure No.	Participant Link	Approximate Distance (km)
3.3.6.1-1	ACR - ACS	50
3.3.6.1-1	ACR - Air Cav Tp	45
3.3.6.1-2	DTOC - Bde S-2	35
3.3.6.1-2	DTOC - DIVARTY (TACFIRE)	10
3.3.6.1-2	DIVARTY - RPV/DIVARTY	8
3.3.6.1-2	DTOC - Engr Bn	8
3.3.6.1-2	DTOC - CEWI Bn (TCAS)	7
3.3.6.1-2	DTOC - REMBASS	10
3.3.6.1-2	DTOC - DISCOM	13
3.3.6.1-2	DTOC - SOTAS MS	12
3.3.6.1-2	DTOC -Div TAC	18
3.3.6.1-2	DTOC - RPV Div	10
3.3.6.1-2	DTOC - C/V Bn	20
3.3.6.1-2	DTOC - PLRS	12
3.3.6.1-2	DTOC - Avn Co.	20
3.3.6.1-2	TACP(Div) - TACP (Bde)	35
3.3.6.1-3	Bde S-2 - DS Bn	6
3.3.6.1-3	Bde S-2 - Bn S-2	12
3.3.6.1-3	Bde S-2 - REMBASS	8
3.3.6.1-3	Bde S-2 - RPV BDE	7
3.3.6.1-3	TACP(Bde) - TACP(Bn)	12
3.3.6.1-3	TACP(Bde) - AFAC	12
3.3.6.1-3	Bn S-2 - Co Comdr	5
3.3.6.1-3	TACP(Bn) - GFAC	7

3.3.6.1.3 Maximum Distances. Table 3.3.6.1.3-1 shows the maximum distances that could exist between any set of participants. In determining these distances, consideration was given to the largest distance for any set of participants as shown by the schematics as well as what is considered the worst possible case based on knowledge from past military experience. This table does not include distances from ground elements to aircraft.

3.3.6.2 Connectivity. Figures 3.3.6.2-1 and 3.3.6.2-2, respectively, depict Corps and Division Battlefield Intelligence Collection and Dissemination Connectivity Diagrams. It is not possible to show the aircraft that could be involved in air reconnaissance but the diagrams do indicate some of the points of interface with the aircraft. Not all the points of interface with the aircraft are shown on the diagrams. All ground terminals should possess the capability of interfacing with the aircraft. When used with figures 3.3.6.1-1, 3.3.6.1-2, and 3.3.6.1-3, these diagrams provide a basis for determination of where in the network relays may be required because of distance separation of participants. The lines of connectivity are based on information flow that currently exists for intelligence collection and dissemination by use of tactical FM radio and multichannel facilities. To show the entire Corps area, it would be necessary to have 4 division connectivity diagrams with the Corps Connectivity diagrams.

Table 3.3.6.1.3-1 Table of Maximum Distances

Participant Link	Maximum Distance (km)
CTOC - DTOC	75
CTOC - ACR	100
CTOC - Air Cav Tp	100
CTOC - IH Gp	75
CTOC - CEWI Gp	30
CTOC - AE Bn	50
CTOC - Engr Bde	80
CTOC - Corp. Main	60
CTOC - COSCOM	90
CTOC - Corp Rear	90
CTOC - Separate Bde	90
CTOC - TACC	35
CTOC - AMS	65
DASC - TUOC	55
DASC - TACC	55
TACC - TUOC	40
DASC - TACP (Div)	75
DASC - TACP (Bde)	125
DASC - TACP (Bn)	140
Engr Bde - Engr Bn	125
CEWI Gp - CEWI Bn	70
CEWI Gp - AE Bn	20

Table 3.3.6.1.3-1 (continued)

Participant Link	Maximum Distance (km)
ACR - ACS	65
ACR - Air Cav Tp	65
DTOC - Bde S-2	45
DTOC - DIVARTY	40
DIVARTY - RPV/DIVARTY	20
DTOC - Engr Bn	20
DTOC - CEWI Bn	10
DTOC - REMBASS	15
DTOC - DISCOM	20
DTOC - SOTAS MS	15
DTOC - Div TAC	20
DTOC - RPV DIV	15
DTOC - C/V Bn	25
DTOC - PLRS	15
DTOC - Avn Co.	25
TACP(Div) - TACP(Bde)	45
Bde S-2 - DS Bn	10
Bde S-2 - Bn S-2	20
Bde S-2 - REMBASS	10
Bde S-2 - RPV BDE	10
TACP(Bde) - TACP(Bn)	20
TACP(Bde) - AFAC	20
Bn S-2 - Co Comdr	15
TACP(Bn) - GFAC	10

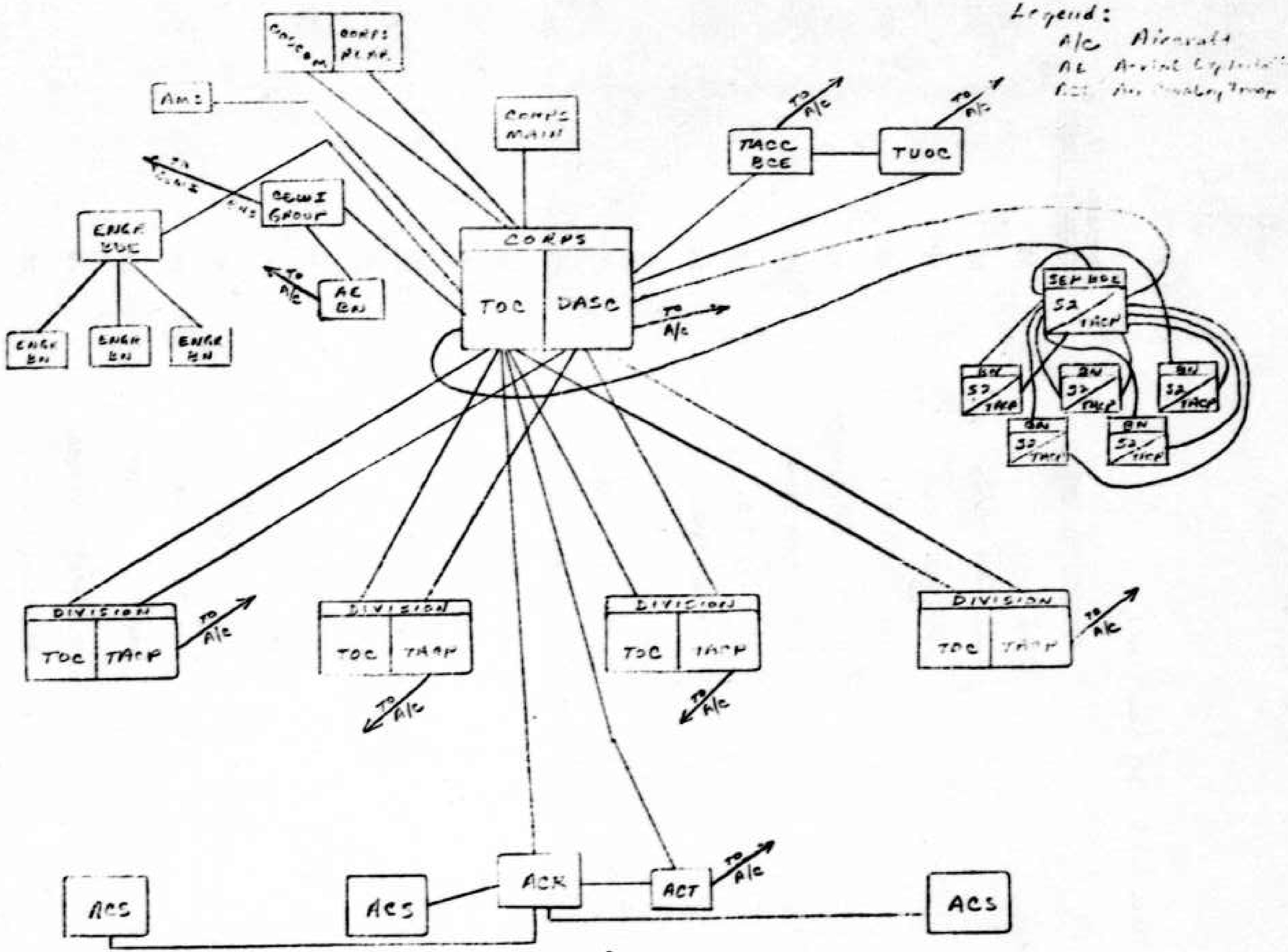

Figure 3.3.6.2-1 Corps Battlefield Intelligence Collection and Dissemination Connectivity Diagram

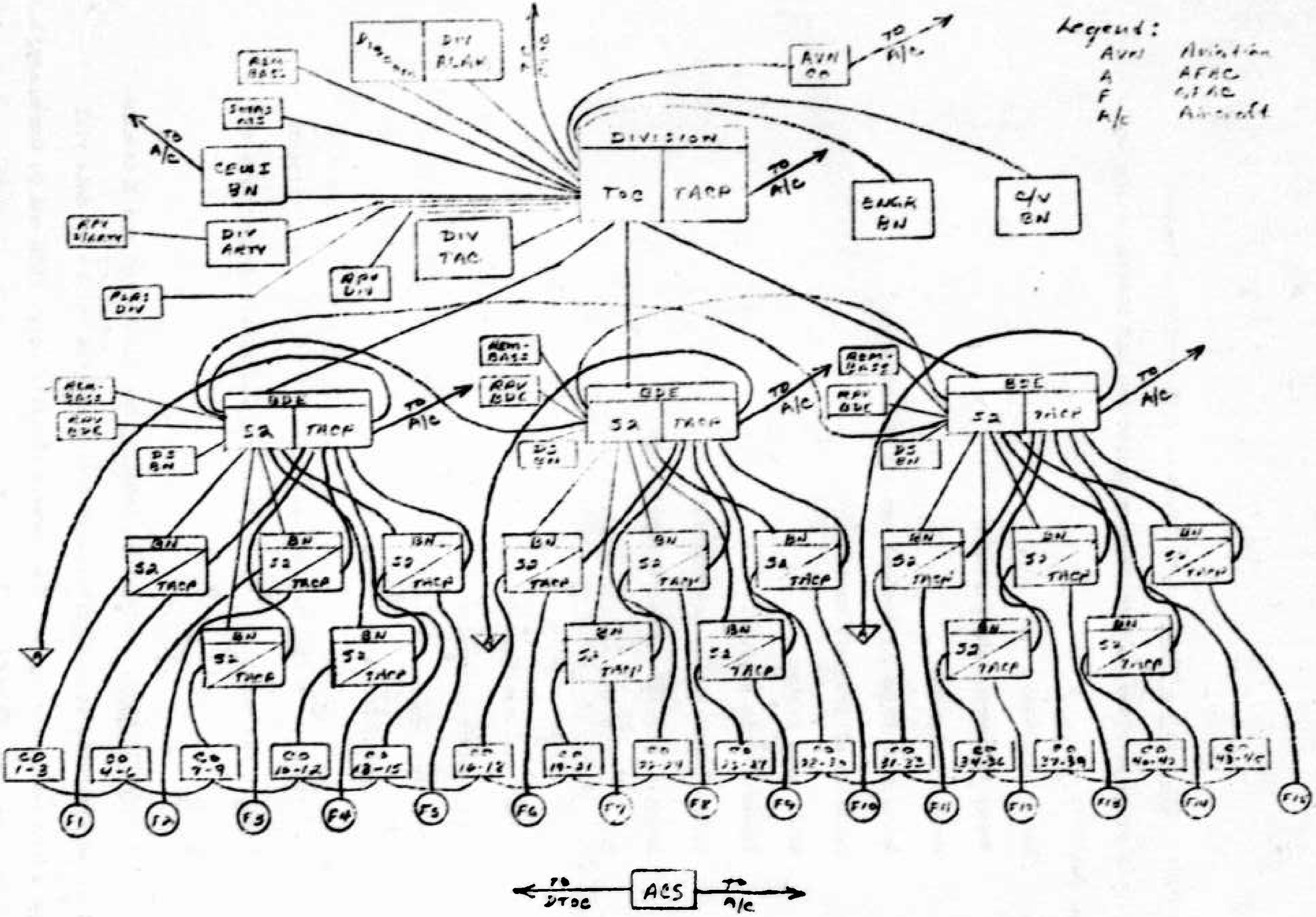

Figure 3.3.6.2-2 Division Battlefield Intelligence Collection and Dissemination Connectivity Diagram

3.3.6.3 Information Types. Some types of data that flow between participants involved in intelligence collection and dissemination are as follows:

Enemy locations

Enemy deployment and movement

Potential targets

Results of friendly actions against the enemy

Location of friendly units

Enemy unit status

Friendly unit status

Plans, coordination and control

Requests for intellignece information

Coordination and control measures

Enemy situation data

Friendly situation data

Intelligence summaries

Situation Reports

In-flight Reports

In the intelligence collection and dissemination efforts, participants would possess the capability of transmitting and receiving messages by digital means.

3.3.6.4 Traffic Flow. Within the intelligence collection and dissemination environment, it can be expected that a certain volume of data will pass between participants. For forward elements (e.g. FACS and Co Commanders),

it is expected that 100 messages will be transmitted and 50 messages will be received during a 24 hour period. It is expected that the peak hour volume will be about 10% of the 24 hour volume. When we get back to battalion level and higher, we can expect the volume to be much greater. A brigade, is expected to handle on the order of 400-500 messages input and a like quantity output, within a 24 hour period peak hour volume estimated at 10% of the 24 hour volume.

3.3.6.5 Timing Requirements. Timing is based on the length of messages to be transmitted and received. Those users employing TOS equipment will be transmitting at a bit rate of 600 or 1200 bps. The message format to be used in TOS has a maximum of 1024 characters. It is expected that with intelligence reporting, many of the messages transmitted and received will approach the maximum because of the types of information included in the messages. A more efficient message structure could be developed to take advantage of JTIDS characteristics, however, many intelligence messages will still consist of fairly voluminous textual material. Required access time (time to access the net) should be less than 15 seconds for sensor-weapon links.

3.3.7 TOS. This paragraph discusses the various factors in relationship to the participants operating in a TOS network. Paragraph 3.3.6, battlefield intelligence collection and dissemination, included the participants of TOS because TOS provides for intelligence data reporting.

3.3.7.1 Geographical Relationships. Figures 3.3.7.1-1 (corps area), 3.3.7.1-2 (Center Division Slice), and 3.3.7.1-3 (Lower Brigade Slice) depict typical deployment of TOS participants and shows the information flow paths by which TOS data is passed back and forth between the participants. Table 1.2.10-1 shows the various TOS participants. For this scenario, the separate brigade, with its 5 maneuver battalions, assigned to Corps, is uncommitted and held in reserve. It is depicted only as the brigade. The brigade headquarters and each of its battalion headquarters must possess Class 3 terminal capability to operate when committed and during the time they are in reserve. The CTOC depicted in the schematic includes the Intelligence element, the Operations element, and the BCC. Each DTOC depicted includes the Intelligence element and the operations element. Because of differences in functions, each of the elements may require an individual Class 3 terminal.

3.3.7.1.1 Identity Codes. Identity Codes were not developed for the participants in TOS. Approximate and maximum distances are based on a general analysis of the three schematics and documented by participants link in general.

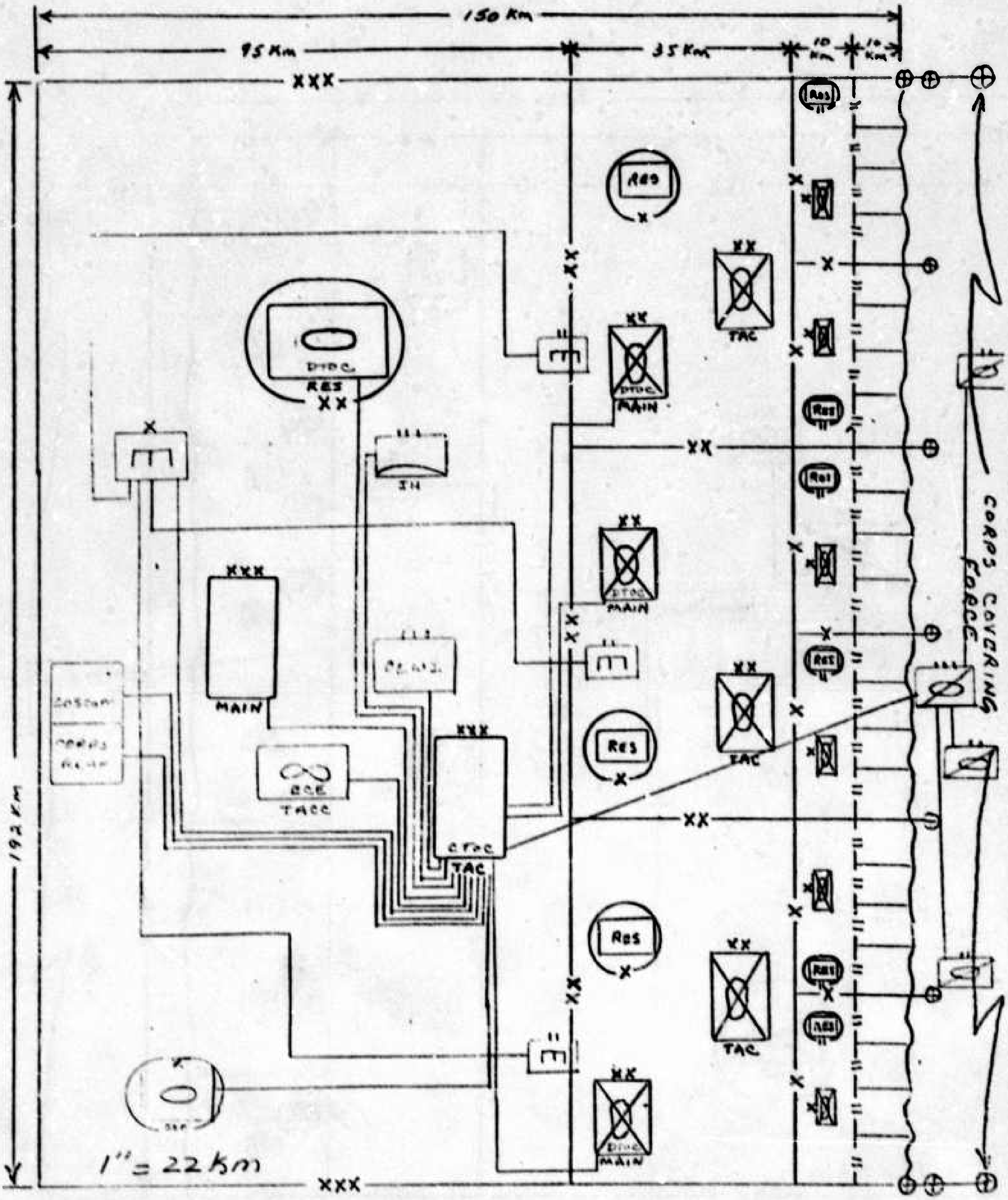

Figure 3.3.7.1-1 Type Corps Area of Operations with TOS Participants and Lines of Information Flow

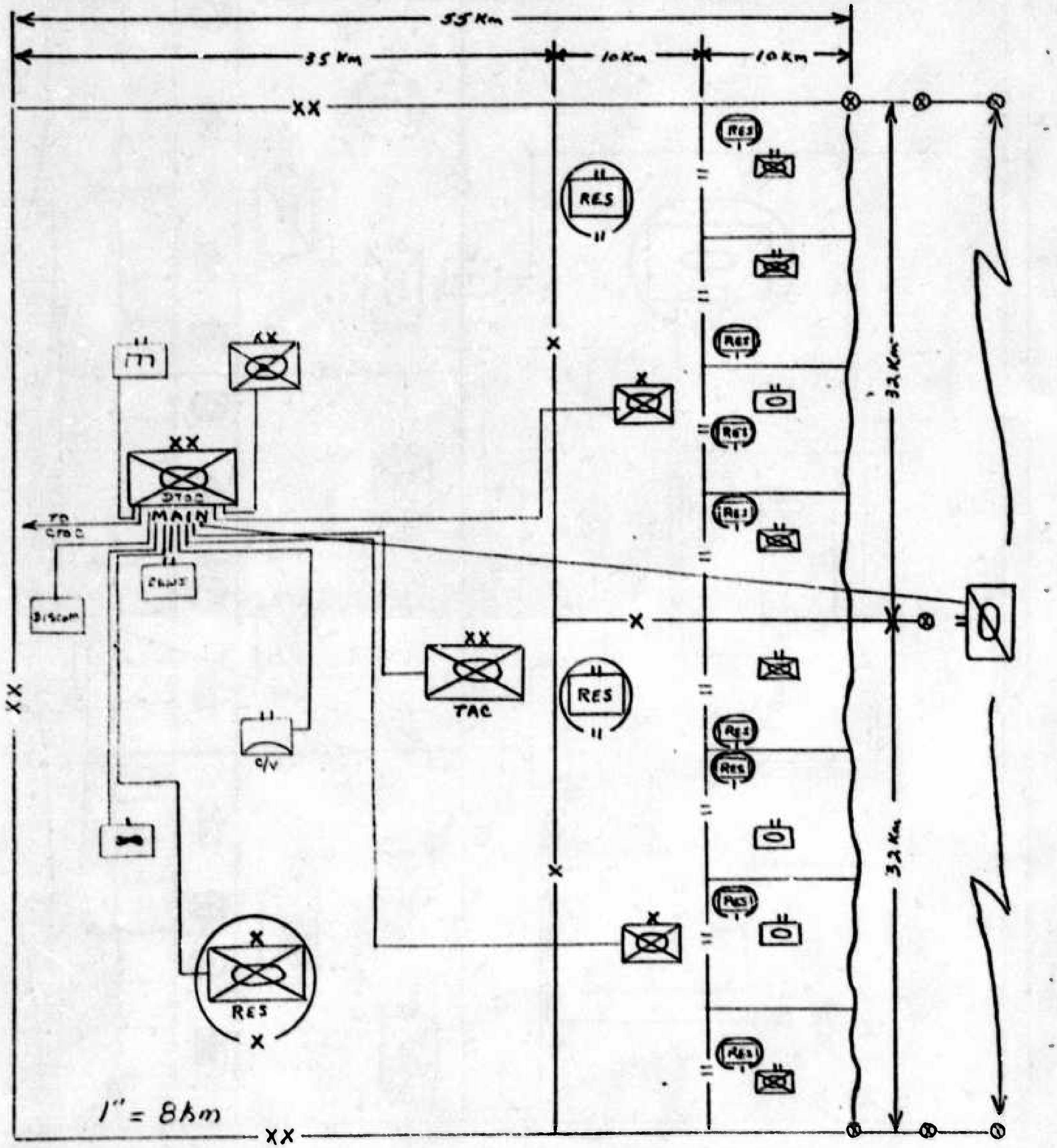

Figure 3.3.7.1-2 Type Division Area of Operations with TOS Participants and Lines of Information Flow

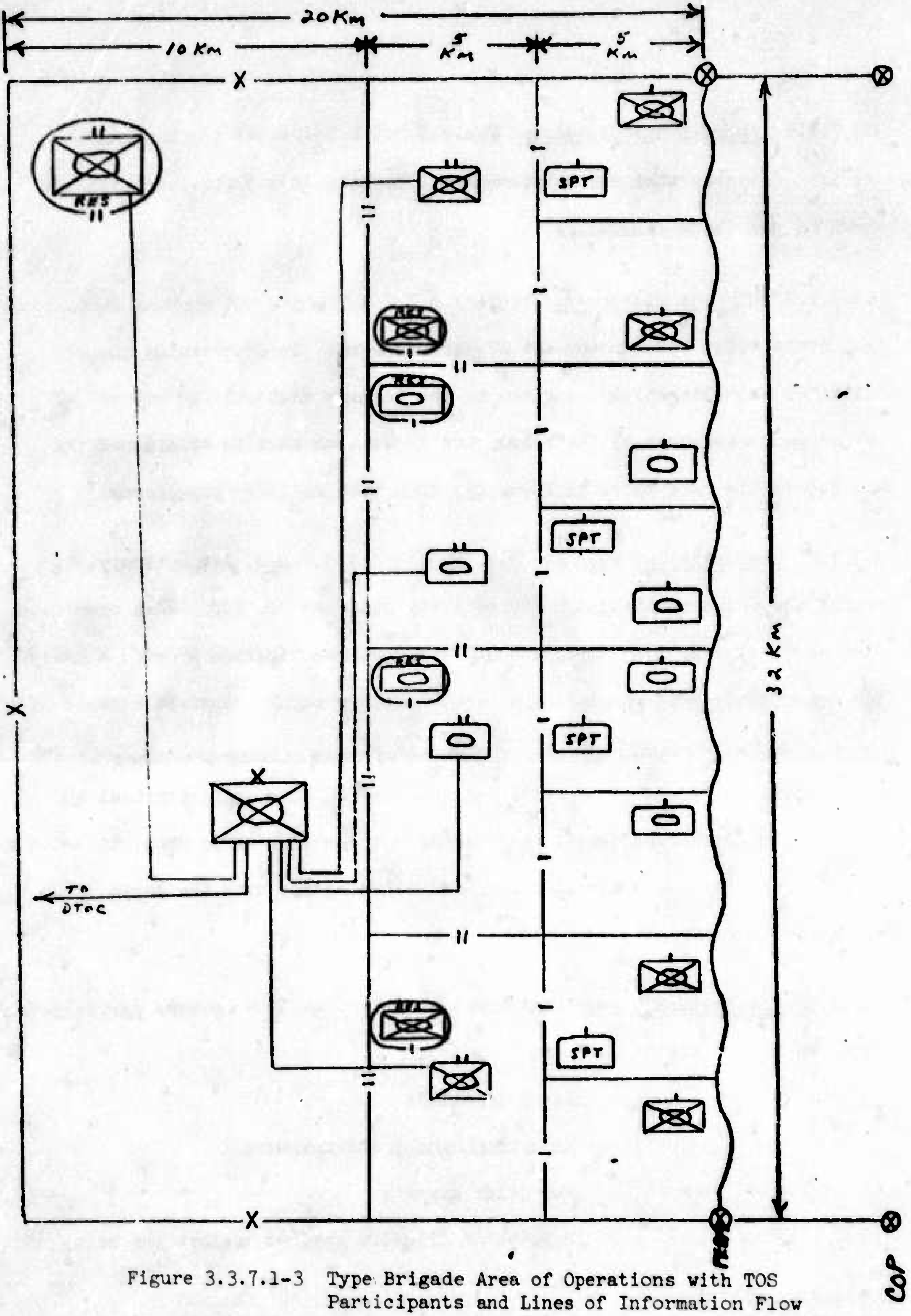

Figure 3.3.7.1-3 Type Brigade Area of Operations with TOS Participants and Lines of Information Flow

3.3.7.1.2 Approximate Distances Table 3.3.7.1.2-1 shows the approximate average distances that exist between participants in a participant link as shown on the three schematics.

3.3.7.1.3 Maximum Distances. Table 3.3.7.1.3-1 shows the maximum distances that could exist between any set of participants. In determining these distances, consideration was given to the largest distance for any set of participants as shown by the schematics as well as what is considered the worst possible case based on knowledge from past military experience.

3.3.7.2 Connectivity. Figures 3.3.7.2-1 and 3.3.7.2-2, respectively, depict the Corps and Division Connectivity Diagrams for TOS. When used with figures 3.3.7.1-1, 3.3.7.1-2, and 3.3.7.1-3, these diagrams provide a basis for determination of where in the network relays may be required because of the separation of participants. The lines of connectivity are based on information flow that currently exists for TOS data using tactical FM radio and multichannel facilities. To show the entire corps area, it would be necessary to have 4 division connectivity diagrams with the corps connectivity diagram.

3.3.7.3 Information Types. Some types of data that flow between participants involved in TOS are as follows:

Enemy locations

Enemy deployment and movement

Potential targets

Results of friendly actions against the enemy

Table 3.3.7.1.2-1 Table of Approximate Distances

Taken from Figure No.	Participant Link	Approx. Dist. (Km)
3.3.7.1-1	CTOC - DTOC	60
3.3.7.1-1	CTOC - COSCOM	77
3.3.7.1-1	CTOC - Corps Rear	77
3.3.7.1-1	CTOC - TACC (BCE)	30
3.3.7.1-1	CTOC - Corps Main	50
3.3.7.1-1	CTOC - Separate Bde	77
3.3.7.1-1	CTOC - IH Group	66
3.3.7.1-1	CTOC - CEWI Group	28
3.3.7.1-1	CTOC - Engr Bde	77
3.3.7.1-1	CTOC - ACR	85
3.3.7.1-1	ACR - ACS	50
3.3.7.1-1	Engr Bde - Engr Bn	95
3.3.7.1-2	DTOC - DIV TAC	18
3.3.7.1-2	DTOC - DIVARTY	10
3.3.7.1-2	DTOC - DISCOM	13
3.3.7.1-2	DTOC - CEWI Bn	7
3.3.7.1-2	DTOC - C/V Bn	20
3.3.7.1-2	DTOC - Avn Co	20
3.3.7.1-2	DTOC - Engr Bn	8
3.3.7.1-2	DTOC - Bde	35
3.3.7.1-3	Bde - Maneuver Bn	12

Table 3.3.7.1.3-1 Table of Maximum Distances

Participant Link	Max. Dist. (Km)
CTOC - DTOC	75
CTOC - COSCOM	90
CTOC - Corps Rear	90
CTOC - TACC (BCE)	35
CTOC - Corps Main	60
CTOC - Separate Bde	90
CTOC - IH Group	75
CTOC - CEWI Group	30
CTOC - Engr Bde	80
CTOC - ACR	100
ACR - ACS	65
Engr Bde - Engr Bn	125
DTOC - DIV TAC	20
DTOC - DIVARTY	40
DTOC - DISCOM	20
DTOC - CEWI Bn	10
DTOC - C/V Bn	25
DTOC - Avn Co	25
DTOC - Engr Bn	20
DTOC - Bde	45
Bde - Maneuver Bn	20

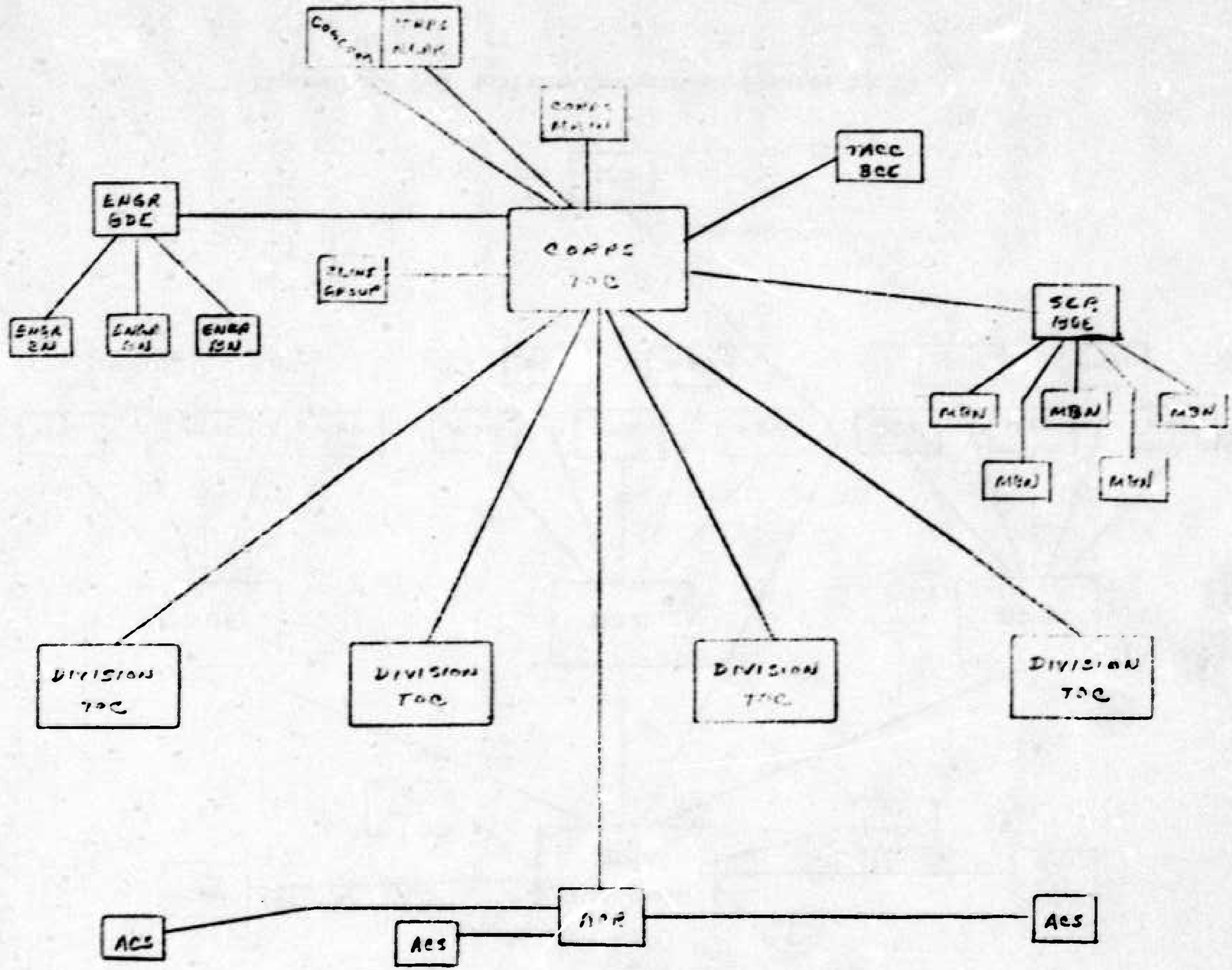

Figure 3.3.7.2-1 Corps Connectivity Diagram for TOS

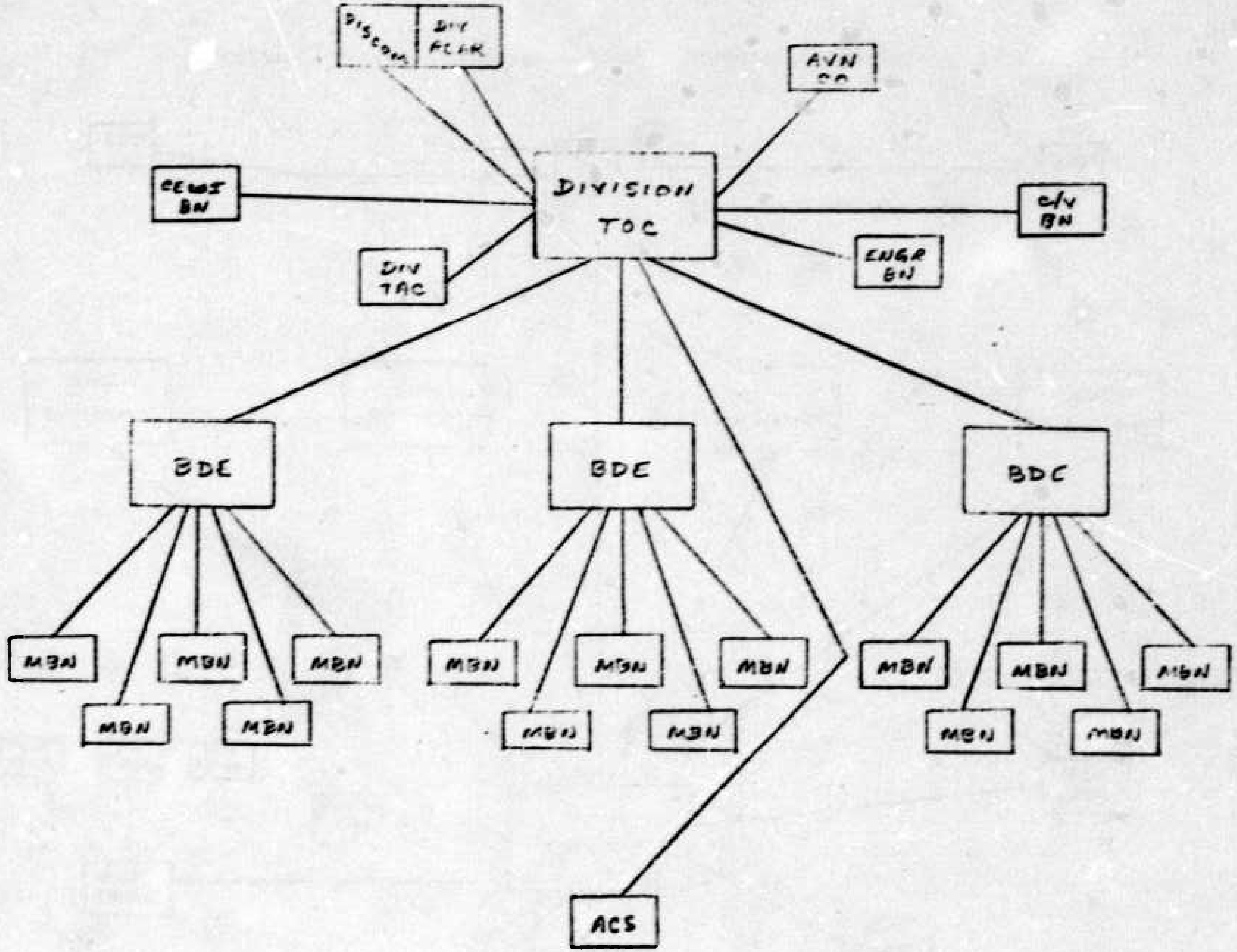

Figure 3.3.7.2-2 Division Connectivity Diagram for TOS

Location of friendly units

Enemy unit status

Friendly unit status

Plans, coordination and control

Requests for intelligence information

Coordination and control measures

Enemy situation data

Friendly situation data

Intelligence summaries

Situation reports

TOS users would be transmitting and receiving messages by digital means.

3.3.7.4 Traffic Flow. Within the TOS environment, it can be expected that a certain volume of data will pass between participants. A brigade, processing by use of TOS, is expected to handle on the order of 400-500 messages imput and a like quantity output within a 24 hour period, with the peak hour volume estimated at 10% of the 24 hour volume. At the division and corps TOCs, it is expected that the volume will probably be twice this volume with the peak hour volume estimated at 10% of the 24 hour volume.

3.3.7.5 Timing Requirements. Timing is based on the length of messages to be transmitted and received. It is estimated that these users of TOS will be transmitting at a bit rate of 600 or 1200 bps. The message format to be used in TOS has a maximum of 1024 characters. It is expected that with intelligence reporting in TOS, many of the messages transmitted and received

will approach the maximum because of the types of information included in the messages. Required access time for TOS users should probably be on the order of 30 seconds.

3.3.7.6 Interoperability. INTEROP IIIa developed potential interfaces between other tactical data system and TOS with TOS becoming a centroidal system. The technical feasibility analysis of INTEROP IIIa indicated whether or not certain described potential interfaces could be accomplished and some traffic volumes that could be expected between the various systems and TOS. INTEROP IIIa identified the following potential interfaces at division level:

	Traffic Volume	
Participant Link	TOS Input	TOS Output
TOS - SOTAS DIV MS	510	40
TOS - MISSILE MINDER AADCP	40	20
TOS - RPV/DIV GCS	235	55
TOS - PLRS/DIV MU	300	30
TOS - ARTINS/CORPS TC	20	60
TOS - MAGIIC/CORPS	30	10
TOS - TCAS/DSCOC	(Classified----------	)
TOS - REMBASS/DIV MS	335	45
TOS - TACFIRE/DIVARTY	570	570
TOS - AMS/CORPS WC	10	0

With interoperability initiated as established by INTEROP IIIa, the total volume, handled by TOS at the Division Computer Center (collocated with the DTOC), as indicated in paragraph 3.3.7.4 can expect to increase by the traffic volume shown above. As can be seen, this represents a major increase in digital traffic for TOS. Adoption of JTIDS transmission schemes offers a potential for decreasing this load by precluding the unnecessary repetition of messages. Under a JTIDS application for Intelligence collection and dissemination as described in paragraph 3.3.6, all potential users of information, either raw data or processed intelligence, would have access to it as it is placed into the net.

3.3.8 Remote Piloted Vehicle (RPV)

This paragraph discusses the various factors in relationship to the participants operating in a Naval environment using the RPV. Because of the classified nature of some of the information, the discussion is contained in a separate classified supplement. The discussion in the classified supplement will follow the identical paragraph numbering as if it had appeared here.

3.3.9 Landing Craft Control. This paragraph discusses the various factors in relationship to the landing craft control participants operating in an amphibious assault.

3.3.9.1 Geographical Relationships. The landing force is only a part of the total amphibious force and is represented by the assault craft (AALCs) and their initial launch platforms, the LHAs, LPDs, and LSDs. Figure 3.3.9.1-1 provides a concept of the employment of the amphibious force. The launch platforms would move forward to about 10-15 miles from shore and launch the AALCs for the assault of the beach. Protection for the assault craft is provided by fighters and helicopter gunships. A look back at table 1.2.13.1 indicates that for the scenario given there are 2 LHAs (with 2 AALC each), 4 LPDs (with 4 AALC each), and 4 LSDs (with 2 AALC each) providing a total of 28 assault craft (AALC) that will be operating in the two AALC landing areas.

3.3.9.1.1 Distances. Distances are relative to the Amphibious Force Launch area. The distances from the launch platforms (LHA, LPD, and LSD) to the assault craft (AALC) will vary from the launch point to the beach area (10-15 miles from the launch platform). Distances from the various AALCs will vary considerably with the AALC moving from launch platform to shore. The distance between landing areas would vary dependent upon the size of the amphibious assault force and the type of operation. They could be quite close to each other or far removed from each other.

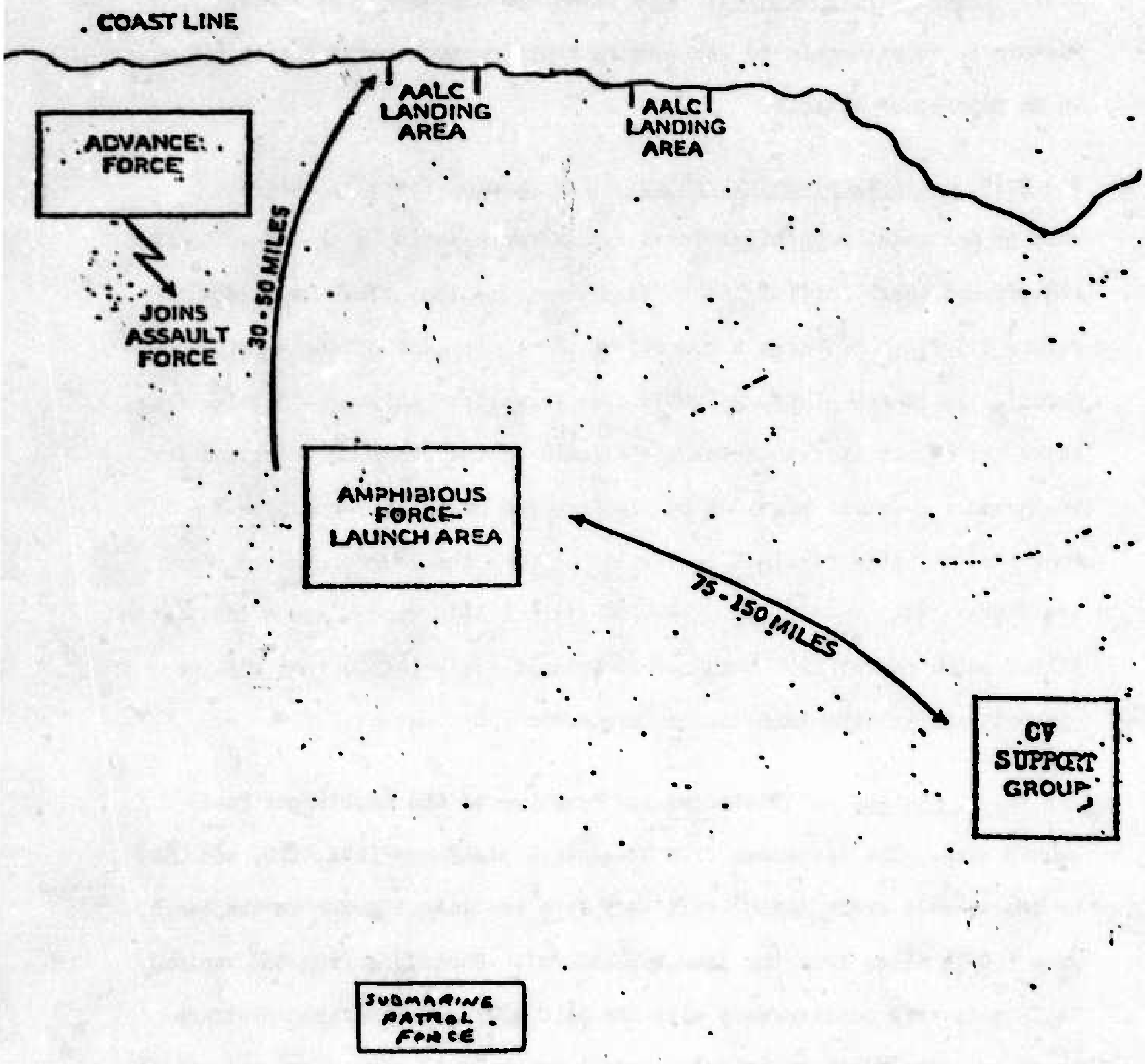

Figure 3.3.9.1-1 Concept of Amphibious Assault Force Employment

3.3.9.2 <u>Connectivity</u>. No connectivity diagram has been prepared for this network, however, all participants including the launch ships and assault craft, would have to possess the capability of interchanging information pertinent to the control of the landing.

3.3.9.3 <u>Information Types</u>. Some of the types of data that flow between participants in the landing craft control environment are as follows:

Position data

Control Measures

Command Messages

Status Messages

It is expected that all of the transmissions will be by digital communications. The information media between participants must:

- Provide position, status, and identification of landing craft to the Landing Craft Control Officer.
- Provide position and control measures to the landing craft coxswain.
- Provide capability to communicate control measures and commands to the landing craft.

3.3.9.4 <u>Traffic Flow</u>. For landing craft control, it can be expected that a certain volume of data will pass between participants. Here we are dealing with a requirement to pass information within the span of time that the assault craft is traversing the distance between the launch ship and the shore and returning to the launch ship. The types of information to be passed

between participants requires a simple graphic display in the landing craft that lets the coxswain see his position relative to control measures. The display must also provide a capability of displaying a limited set of commands for the direction of the landing craft. A more elaborate display is required for the Landing Craft Control Officer (LCCO) and may be a part of the shipboard class 2 terminal. Because of the criticality of the position data, it is expected that information to the display in the landing craft would be updated about once every ten seconds. This indicates that the volume of traffic received by the landing craft would be on the order of 360 messages per hour. The messages transmitted from the landing craft would be approximately the same to provide relative navigation data to adjacent landing craft. The volume at the launch ships will be considerably greater since they will be transmitting and receiving from several assault craft as well as other amphibious force ships. Note that the terminals at the launch ships are possibly class 1 or 2 terminals.

3.3.9.5 Timing Requirements. It is expected that the digital messages transmitted and received will be of relatively short duration probably only a single time slot. The criticality of position data requires constant updating probably on the order of every 10 seconds. It is estimated that the required access time (time to access the network) should be about 5 seconds.

3.3.10 Forward Terminal Operations. This paragraph discusses the various factors in relationship to the participants of the "Bare Base" combat Control Teams (CCT) and supporting ground assault teams deployed as an advanced force during airborne operations. The purpose of this force is to locate, identify, and mark the drop and landing zones; establish and operate terminal navigation aids; and guide aircraft serials to the proper drop or landing zone.

3.3.10.1 Geographical Relationships. Normally airborne operations are initiated by an assault phase. This phase is executed employing parachute and assault aircraft to secure an initial airhead or multiple airheads in hostile territory. It is during this phase that the CCT and supporting ground assault teams are in operation securing the airhead and establishing communications for guiding aircraft serials to the drop or landing zones. Figure 3.3.10.1-1 depicts a type area of operation for a division assault. The CCT and supporting ground assault forces would be operating within the area outlined by the airhead line. The extent of the area of coverage will vary from mission to mission dependent upon the size of the force that is conducting the assault. The mission determines the exact location and extent of the airhead. Security forces are established including combat outposts. These outposts normally are located about 4 to 8 kilometers beyond the airhead line.

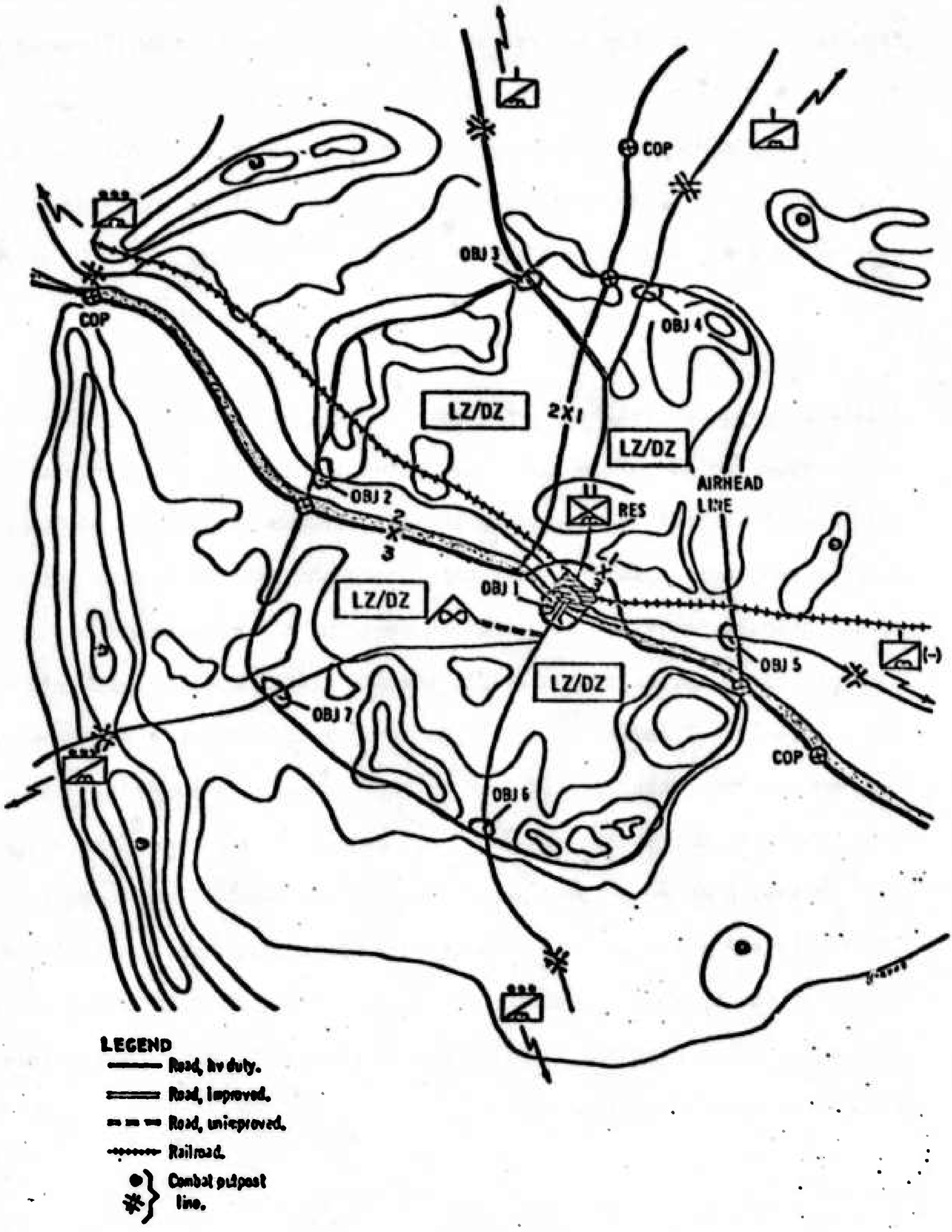

Figure 3.3.10.1-1 Type Area of Operation for Airborne Division Assault

3.3.10.1.1 Distances. The distances we are concerned with are those between participants operating within the airhead line as well as to the security forces which are deployed outside the airhead line. For the typical type of operation shown, it is estimated that the area within the airhead line is formed by an irregular circle with a radius of about 10km. Therefore, the maximum distance between any set of participants operating within the airhead line would be 20km. The distances between participants within the airhead line and the security forces operating the combat outpost line would be on the order of 14 to 18km. A maximum distance between security force participants can be expected to be about 36km. In addition, it must be considered that the armored cavalry squadron of the airborne division will be deployed beyond the combat outpost line and will range from 16 to 24kms beyond the airhead.

An airborne assault such as this is usually conducted well within enemy held territory and could be an assault into the rear areas of the enemy. Therefore, we are talking about distances that could be 10s of km to 100s of km forward of the FEBA. The units operating in this assault area must possess the capability not only to intercommunicate with their higher headquarters (regardless if located behind the FEBA or on the move in aircraft) but also with the aircraft that will be bringing in the balance of the force.

3.3.10.2 Connectivity. No connectivity diagram has been prepared for this network, however, all participants, including members of the CCT, members of the supporting assault team, security force, parent unit headquarters,

and all airlift aircraft must possess the capability of interchanging information pertinent to the airhead operations.

3.3.10.3 Information Types. Some of the types of data that flow between participants in the "Bare Base" operations are as follows:

Position data

Landing zone and drop zone identification

Control measures

Command and coordination messages

Status messages

Intelligence information

3.3.10.4 Traffic Flow. Here we are dealing with the traffic necessary to provide effective guidance to aircraft serials and also that information transfer required between CCT Participants and the supporting assault force to coordinate actions. Communications from the objective area (airhead operations area) is necessary with airlift forces, higher headquarters, supporting tactical air elements, the airlift departure area, and other supporting elements. A simple graphic display as part of the Class 3 terminal is desirable for the participants in the "bare base" operation to assist in relative positioning and for optical display of a limited set of commands for control of "bare base" operations. Position location is a critical matter for direction of aerial serials. It is expected that data would have to be updated about every 20 seconds. For ground control of incoming aircraft, it expected that data would require updating about every 2 - 5 seconds.

This indicates a traffic volume of about 180 messages an hour in both directions. It is expected that airborne platforms will possess class 2 terminals.

3.3.10.5 Timing Requirements. It is expected that messages transmitted and received will be digital and that they will be of short duration probably fitting a single time slot. Criticality of position data requires constant updating of information probably on the order of every 2 - 5 seconds for ground control of incoming aircraft. It is estimated that the required access time (time to access the network) should be about 10 seconds.

3.3.11 Beachhead/Airhead Operations. This paragraph discusses the various factors in relationship to the participants of beachhead or airhead operations. In each case, we are dealing with the control and coordination of a large volume of supplies, troops, and equipment being pushed through a relatively small, compact area in a short span of time. The need to provide effective and efficient control and coordination is critical and JTIDS appears to be a system that can provide the required communications media to accomplish the control and coordination.

3.3.11.1 Geographical Relationships. No individual schematic is provided in this paragraph since any one of two previous figures would depict typical landing areas. Figure 3.3.9.1-1 provides a concept of the employment of the amphibious force showing the landing areas. The beachhead operations would involve the control of all landing craft, the troops, supplies, and equipment as they are landed and proceed with the missions ashore. Figure 3.3.10.1-1 shows a type area of operation for an airborne division assault. The airhead operations would involve the control of all landings of troops, supplies, and equipment within the airhead and dispersion to accomplish the missions of the assault force.

During an amphibious operation, the beachmaster must maintain continuous liasion with the amphibious task force commander. The beachmaster and

his unit are responsible for preparation of the beach and its approaches, determination and marking of landing sites, control of embarkation, control of salvage operations, and assistance in the evacuation of prisoners and casualties. In like manner, the airhead operations are characterized by similar functions which require very stringent control and coordination. In both cases, this is a definite requirement for the type communications that can be provided by JTIDS.

The mission of the assault force determines the exact location and extent of the beachhead or airhead. We assume in either case that the assault force being employed is a divisional size unit.

3.3.11.1.1 Distances. It is quite difficult to determine what actual distances may exist between participants. However, if we use the estimated distances discussed in paragraph 3.3.10.1.1 for the "bare base" operations, we can say that it is expected that the maximum distance between any set of participants operating within the airhead or beachhead would be about 20km. When dealing with participants outside the airhead line, forward shore elements, or with participants that are still off-shore, we find that the distances increase. To forward elements and security forces, the distances could range up to about 25km from the airhead line or from the beachhead. To those participants still off-shore, the distance separation could range up to 10 - 15 miles or more. However, the most critical communications will be that required close-in while troops, supplies and equipment are being off-loaded and dispersed throughout the assault area.

3.3.11.2 Connectivity. No connectivity diagram has been prepared for this network because of lack of specific details pertaining to the physical number of participants that may be involved. However, all participants that are directly involved in the control and coordination of the flow of troops, supplies, and equipment through the airhead or beachhead must possess the capability of interchanging information pertinent to the operations.

3.3.11.3 Information Types. Some of the types of data that flow between participants in beachhead/airhead operations are as follows:

Landing directions

Traffic flow data

Command and coordination messages

Position and location data

Landing area, landing zone, and drop zone identification.

Time schedules

Evacuation data

Resupply data

3.3.11.4 Traffic Flow. Here we are dealing with the traffic necessary to provide effective control of vital resources into, through, and out of the airhead or beachhead area. Communications between tactical elements, fire and air support forces, and the logistical elements is necessary to squeeze vast amounts of men and material through a small piece of real estate in the shortest possible time. It is expected that all

traffic will be digital with voice backup being performed via other logistical radio networks. It is expected that a terminal will need to handle about 200 messages in either direction per hour.

3.3.11.5 Timing Requirements. It is expected that digital messages will be of as short a duration as possible and will fit a single time slot. It is estimated that the required access time (time to access the network) should be about 15 seconds.

3.4 RELAY REQUIREMENTS

Several factors must be considered in establishing the relay requirements for JTIDS Class 3 application. The factors that are most significant are as follows:

- Link Distances
- Terminal and Antenna siting
- Propagation characteristics
- Terrain

Each of these is discussed in the following paragraphs.

3.4.1 Link Distances

Link distances, that is the distance between the originator and user of information, are shown in the studies to run over 100 Km. In air-to-air or air-to-ground applications such a distance may well be feasible for line-of-site unrelayed communications. In the ground-to-ground application, however, it will prove extremely difficult to find suitable locations for establishing line-of-site links of such magnitude. When such locations are found, they are often high hill tops or other inaccessible locations that may not be suitable for the mission of the terminal user. In addition, signal attenuation over a ground-to-ground path will also tend to make long paths infeasible without relays.

3.4.2 Terminal and Antenna Siting

As alluded to above, the mission of the user will often force him to accept a location that is not the most desirable from a communications point of view. This is most specifically the case with the front line users in a

ground-to-ground environment. A forward observer will often have to operate from a foxhole or a shell crater. He will have to stay off of topographical crests to avoid detection. His need for mobility will dictate that he use a small antenna. The study has also tended to indicate that users fall into clusters and bands when mapped onto the battlefield. Such grouping may tend to make it difficult to communicate between such clusters or bands, even though communication is relatively easy within each cluster or band.

Clusters result from the tendency of supporting agencies to group around the headquarters they are supporting. Bands are often caused by the use of terrain to shield supporting units such as artillery. Thus such units are found one terrain feature behind the line-of-contact (LOC) creating a band along the LOC and another one terrain feature back. Another band tends to be formed by headquarters of higher echelons and reserve units. Depending on the severity of the terrain this may or may not cause discontinuity in communications.

3.4.3 Propagation Characteristics

The use of microwave frequencies for the JTIDS Class 3 terminal cause it to have little or no refraction around terrain obstacles. This means that ground-to-ground applications of the Class 3 terminal will have to accept strict line-of-site (LOS) operating conditions. LOS restrictions will be even more severe than those experienced with present day tactical FM radios operating at VHF frequencies.

3.4.4 Terrain

For ground-to-ground applications,terrain will often be the limiting factor in establishing LOS paths between terminals. That is, local contours as opposed to earth curvature will be the governing effect. Terrain conditions, of course, range from flat to near vertical, and the Armed Forces will have to be prepared to operate under both extremes. Terrain problems will vary from the flat North German plains to the Rain Forest of southeast Asia to the rugged hill of Korea. The area generally used for evaluation is western Europe. Our troops are not stationed in the flat moors and peat bogs of northern Germany. Rather they must be prepared to fight in the terrain typical of Central and Southern West Germany.

A study of this terrain was conducted in the early 1960s. Its purpose was to determine the most likely engagement ranges for tank battles. Specifically, at what distances would two forces moving toward each other detect and engage each other. It was determined by the study that the expected range of engagement for meeting engagements would be 800 to 1200 meters.

This distance can be considered analogcus to line-of-site distances between tactically moving units whose tactics dictate their choice of position. While not an exact analog, this figure, 800-1200 meters, does indicate that

paths of opportunity between tactically positioned users of Class 3 terminals can be expected to be on the order of a few kilometers at best and not on the order of 10s of kilometers.

3.4.5 Analysis

Taken together, the factors discussed above all indicate the ground-to-ground applications of JTIDS will necessarily involve relays. The JTIDS structure provides inherent relay capabilities, and cooperative measures to provide "relays-of-opportunity" are possible. Problem areas may be created for this approach by three considerations.

- If a limited deployment of JTIDS terminals is made, as for example, only TACFIRE users are equipped with JTIDS, a sufficient density of potential relays may not exist.
- The banding and clustering effect noted above may create gaps between echelons and areas that do not offer sufficient potential relays to allow necessary communication.
- Local terrain conditions will occasionally be encountered that demand specifically positioned relays.

Examination of tactical operations using present day tactical FM equipment provides insight into these situations. Voice radio nets often make use of relay procedures. Very often it is possible to use a relay of opportunity, that is, one member of a net will relay messages between two others who cannot communicate directly. JTIDS will enhance this mode of operation because

JTIDS nets can potentially consist of many more users who are not limited to a specific unit or mission. This will increase the number and geographic distribution of potential relays. This improvement is partially offset by the fact that JTIDS terminals will suffer somewhat more severe LOS restraints than do present day FM radios.

Further examination of present day FM operations discloses that very often dedicated relays are employed. Radios and operators are located specifically and solely for the purpose of relaying between elements that cannot otherwise communicate. Airborne relays though not a desirable use of aircraft resources, are often used, particularly in difficult terrain such as Korea, where positioning ground relays is difficult.

Positioning of a relay for JTIDS will be more critical because of the LOS restrictions, however, a single JTIDS relay will be able to handle far more users than a present day FM relay.

3.4.6 Conclusions

The following conclusions are drawn from the analysis above.

- JTIDS Class 3 terminals used in ground-to-ground applications will often require relays to get messages to their intended destination.
- The inherent relay capabilities of the JTIDS terminals will make "relays-of-opportunity"more effective than with present FM radios.
- Extremes of terrain conditions and/or spread out tactical situations may force the use of dedicated relays on occasion, however, their use

will parallel present day tactical FM relay use.

- Dynamic management of time slot allocations will be needed to ensure optimum relay effectiveness.
- Air-to-air applications and Ground-to-air applications will also require relay capabilities. Under circumstances when long distances must be covered, dedicated relays may be required where the presence of properly positioned cooperating elements cannot be guaranteed. These applications will, however, have less stringent relay requirements than the ground-to-ground applications.

3.5 SCORES SCENARIO 3A COMPARISON

To provide a comparison with SCORES scenario 3A, the units for critical situation #4 were plotted. In this situation, two divisions are being passed through the lines of a brigade area of about 15-18 km in width. Prior to the initial passage, the total Corps front was about 70 km in width. At the ending situation, the total Corps front was about 55 km in width. All of the critical situations covered a forward movement of about 75-80 km.

Plotting the units for critical situation #4 provided a basis for determining some approximate distances. Some representative approximate distances are as follows:

Participant Link	Approx. Dist. (Km)
Corps:	
Corps TAC - Corps Main	15
Corps Main - Corps Rear	32
Corps TAC - Corps Rear	45
Corps TAC - DivArty (5th Mech.)	35
Corps TAC - Div Arty (2d Armd)	10
Corps TAC - DivArty (4th Mech.)	30
Corps TAC - DivArty (8th Mech)	15
Corps TAC - DivArty (3d Armd)	18
Corps TAC - Div (5th Mech)	35
Corps TAC - Div (2d Armd)	10

Corps TAC - Div (4th Mech)	30
Corps TAC - Div (8th Mech)	15
Corps TAC - Div (3d Armd)	18
Corps Arty - Corps FA Bn	35
Corps TAC - ACR	21
ACR - ACS	15

<u>5th Mech Div.:</u>

Div Arty - DS Bn	15
DivArty - GS Bn	15
Div - ADA Bn	23
Div - ACS	15
Div - Bde	17
DS Bn - FO	40

<u>4th Mech Div.:</u>

DivArty - - DS Bn	25
Div Arty - GS Bn	20
Div - ADA Bn	5
Div - ACS	25
Div - Bde	15
DS Bn - FO	10
Bde - Bn	17

8th Mech Div.:

DivArty - DS Bn	4[illegible]
DivArty - GS Bn	37
Div - ADA Bn	25
Div - ACS	50
Div - Bde	32
DS Bn - FO	8
Bde - Bn	14

2d Armd Div.:

Div Arty - DS Bn	12
Div - Bde	27
Div - ACS	20
Div - ADA Bn	5
DS Bn - FO	30

3d Armd Div.:

Div - Bde	27

If we now compare some of these approximate distances with approximate distances developed for the various networks, we see that generally the very large distances have become considerably smaller because of the compacting of units into a relatively smaller area of operation. However, the approximate distances developed above still indicate that in ground-to-ground communications under extreme compacting relays may still be required in some instances to accomplish the transmission between a set of participants. The following provides examples of comparisons of some sets of participants:

Participant Link	Network Analysis Approx Dist. (Km)	SCORES Approx. Dist (Km)
Corps TAC - Corps Main	50	15
Corps TAC - Corps Rear	77	45
Corps TAC - DivArty/Div	73	21
Corps TAC - ACR	65	15
DivArty - DS BN	30	23
Div - ADA Bn	20	15
Div - ACS	53	28
Div - Bde	35	23
Bde - Bn	15	15
DS Bn - FO	15	10

The plotting of the units in this situation showed how the units become compacted into a relatively small frontage while the passage of lines is conducted. A Field Artillery Group from Corps assets provides general support reinforcing artillery coverage for the two divisions while the passage is conducted and division organic artillery is being displaced.

A further analysis of the units for this situation indicates the following ranges of composition of units:

	Range per Division
Brigades	2-5
Maneuver Bns	8-17
DS Arty Bns	0-3
GS Arty Bns	1-8
GSR Arty Bns	0-1
Reinforcing Arty Bns	0-4

If we look at the impact of a passage of lines on current communications, we find that the communications of the unit passing through the line will be restricted. Some circuits of the unit occupying the position, such as through multichannel facilities, may be made available to the unit passing through. Essentially, radio communications will be the prime mode employed, not only between elements of the unit making the passage, but also between the elements of the unit occupying the position and the elements of units making the passage. The frequencies employed and the procedures adopted require extremely careful coordination. Such would also be true with the use of JTIDS networks to preclude interference due to close proximity of units.

It should also be noted that in this scenario elements of 3 divisions are commingled in a single geographical area. It must be mentioned here that such a passage of lines is generally attempted with the units making the passage under conditions of radio silence to preclude premature disclosure of the attack. Nevertheless, this situation strongly implies that essential division communications cannot depend on physical separation from other divisions to allow them to work.

4.0 TERMINAL CHARACTERISTICS SUMMARY

This section provides a summary by network of the terminal characteristics of manpack, vehicular, shipboard, helicopter, and missile/RPV Class 3 terminals. The information for this summary is based upon data developed during the mission profile and network analyses.

For each network defined in section 2.0 and analyzed in section 3.0, a set of tables is provided showing the characteristics of the types of terminals that is is expected would be used in the particular network. Supplemental and amplifying information pertaining to the various tables is provided as notes to each table where applicable.

4.1 TACFIRE

This paragraph presents the terminal characteristics for the manpack, vehicular, and helicopter versions of the Class 3 terminal considered for use in a TACFIRE network. Typical deployment was used in arriving at some of the data. The typical deployment is based on a Corps (consisting of 4 Divisions of 3 Brigades each; each Brigade having 5 Maneuver Battalions) operating in a defensive position covering a frontage of approximately 192 Km and a depth of 150 Km. Tables 4.1-1, 4.1-2, and 4.1-3, respectively, present the characteristics for the manpack, vehicular, and helicopter versions of the Class 3 terminal.

Table 4.1-1 JTIDS Class 3 Manpack Terminal Characteristics (TACFIRE)

CHARACTERISTICS	
Voice	Usage Less than 5%
Data	Primary usage more than 95%
Range (Link Distances):	
Usual	14 km
Maximum	20+ km
Threat	Critical; close proximity to FEBA; direct enemy observation; subject to loss and/or compromise
Estimated Input Requirements: (FO)	
24 hour volume	160 Messages (44 characters fixed format)
Peak hour volume	24 Messages
Estimated Output Requirements: (FO)	
24 hour volume	160 Messages (44 characters fixed format)
Peak hour volume	24 Messages
Required Access Time	20 Seconds

Table 4.1-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (TACFIRE)

CHARACTERISTICS (cont)

Operational Restrictions:

Site Selection	Critical placement; antenna height restricted
Weight	Portable by one man (including power pack)
Endurance	Extended operation away from vehicle of 3 - 4 hours; airborne operations without vehicle 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals Class 1 & 2 under new concepts for FO handling CAS
Display Requirements	DMD Display limited, JTIDS Display desirable for position location data, any other data not available in TACFIRE.
Position Location	Accuracy of 30 meters or less
Navigation	Not Required

Table 4.1-1 (cont'd)

NOTES:

1. Voice - a TACFIRE user can complete all mission requirements by use of digital transmission means. Therefore, voice only needed as backup and for command and control.
2. Data - transmission will be by DMD fixed format messages with a maximum length of 44 characters. TACFIRE currently operates at a serial bit rate of 600 or 1200 bps. Evolution of TACFIRE may produce a more efficient coding system thereby reducing message size.
3. Range - when the Corps or elements of the Corps are on the offensive, the distance shown will decrease considerably to the point where with a passage of lines, the units may be compacted into a very small area and representative distances will be reduced. However, after the passage of lines and revision from offense to a defensive structure, the participants will again be at extended distances. A situation such as that represented here provides the most stressful case in relationship to range.
4. Usual Distance - represents a typical average distance from the Forward Observer to the Direct Support Artillery Battalion.
5. Maximum Distance - represents the maximum distance that can be expected from a Forward Observer to the DS Artillery Battalion.
6. Required Access Time - the time it should take a manpack terminal user to access the net when he wants to transmit a message.
7. Site Selection - consideration must be given to the fact that the FO may be operating in a prone position, in a foxhole, from a bunker, or other like place of concealment. All these factors will affect transmission.

Table 4.1-2 JTIDS Class 3 Vehicular Terminal Characteristics (TACFIRE)

CHARACTERISTICS	
Voice	Usage Less than 5%
Data	Primary usage more than 95%
Range (Link Distances):	
Usual	12 - 18 km
Maximum	100 km
Threat	At least 6 km from FEBA; not under direct enemy observation Loss or compromise remote unless deep penetration by enemy.
Estimated Input Requirements: (DS Bn)	
24 hour volume	4100 Messages (517 characters variable format or 44 characters fixed format)
Peak hour volume	410 Messages
Estimated Output Requirements: (DS Bn)	
24 hour volume	4100 Messages (517 characters variable format or 44 characters fixed format)
Peak hour volume	410 Messages
Required Access Time	30 Seconds

Table 4.1-2 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (TACFIRE)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Site selection not critical; can have higher antenna than manpack
Weight	Not critical; vehicle mounted; uses vehicle prime power
Endurance	No requirements because operates on vehicle power.
Interoperability Requirements	All Class 3 terminals Class 1 & 2 if required to operate in Forward Airspace Management Network.
Display Requirements	Display provided by TACFIRE adequate to handle all requirements. No Class 3 terminals display desired.
Position Location	Accuracy of greater than 30 meters.
Navigation	Not Required

Table 4.1-2 (cont'd)

NOTES:

1. Voice - see note 1 to Table 4.1-1
2. Data - transmission will be in the form of variable format messages with a maximum length of 517 characters. TACFIRE currently operates at a serial bit rate of 600 or 1200 bps. Evolution of TACFIRE may produce a more efficient coding system thereby reducing message size.
3. Range - see note 3 to Table 4.1-1.
4. Usual Distance - represents a range of normal operating distances based on a weighted average for all vehicular terminal participants.
5. Maximum Distance - represents the most extreme distance that can be expected between a set of participants.
6. Required Access Time - see note 6 to Table 4.1-1.

Table 4.1-3 JTIDS Class 3 Helicopter Terminal Characteristics (TACFIRE)

CHARACTERISTICS	
Voice	Usage Less than 5%
Data	Primary usage more than 95%
Range (Link Distances):	
Usual	44 km
Maximum	50 km
Threat	Critical; close proimity to FEBA; direct enemy observation.
Estimated Input Requirements: (AO)	
24 hour volume	40 Messages (44 characters fixed format)
Peak hour volume	6 Messages
Estimated Output Requirements: (AO)	
24 hour volume	40 Messages (44 characters fixed format)
Peak hour volume	6 Messages
Required Access Time	20 Seconds

Table 4.1-3 (cont'd)

JTIDS Class 3 Helicopter Terminal Characteristics (TACFIRE)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Antenna height makes no difference; no site selection; on the move; direct enemy observation
Weight	May be limited by helicopter mounting; otherwise not critical.
Endurance	No requirement; operates on aircraft power.
Interoperability Requirements	All Class 3 terminals Class 1 & 2 if required to operate in Forward Airspace Management Network.
Display Requirements	On board display is desireable to provide position Location and navigational aid; DMD display has limited capability.
Position Location	Accuracy of 30 meters or less
Navigation	Required

Table 4.1-3 (cont'd)

NOTES:

1. Voice - see note 1 to Table 4.1-1.
2. Data - see note 2 to Table 4.1-1.
3. Range - see note 3 to Table 4.1-1
4. Usual Distance - represents a typical average distance between an AO and the Div Arty FDC.
5. Maximum Distance - represents the maximum distance that can be expected between an AO and the Div Arty FDC.
6. Required Access Time - see note 6 to Table 4.1-1.

4.2 MIFASS

This paragraph presents the terminal characteristics for the manpack and vehicular versions of the Class 3 terminal considered for use in a MIFASS network. Typical deployment of a divisional size Marine Force was used in arriving at some of the data. Tables 4.2-1 and 4.2-2, respectively, present the characteristics for the manpack and vehicular versions of the Class 3 terminal.

Table 4.2-1 JTIDS Class 3 Manpack Terminal Characteristics (MIFASS)

CHARACTERISTICS	
Voice	Usage about 30%
Data	Usage about 70%
Range (Link Distances):(Observer-Bn FASC)	
Usual	6 km
Maximum	10 km
Threat	Critical; close proximity to FEBA; direct enemy observation; subject to loss and/or compromise.
Estimated Input Requirements: (Observer)	
24 hour volume	140 Messages (DMD fixed format) (100-300 bits)
Peak hour volume	21 Messages
Estimated Output Requirements: (Observer)	
24 hour volume	140 Messages (DMD fixed format) (100-300 bits)
Peak hour volume	21 Messages
Required Access Time	1 Second

Table 4.2-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (MIFASS)

CHARACTERISTICS (cont)

Operational Restrictions:	
Site Selection	Critical placement; antenna height restricted
Weight	Portable by one man (including power pack)
Endurance	Extended operations away from vehicle of 6-8 hours.
Interoperability Requirements	All Class 3 terminals; Class 1 & 2 for coordinating CAS.
Display Requirements	JTIDS display may be required due to display limitations inherent in MIFASS DMD.
Position Location	Accuracy of 30 meters or less
Navigation	Not Required; uses PLRS

Table 4.2-1 (cont'd)

NOTES:

1. Usual Distance - represents a typical average distance from an Observer to the Bn FASC.
2. Maximum Distance - represents the maximum distance that can be expected between an observer and the Bn FASC.
3. Required Access Time - the time it should take a manpack terminal user to access the net when he wants to transmit a message.
4. Site Selection - consideration must be given to the fact that the observer may be operating in a prone position, in a foxhole, from a bunker, or other like place of concealment. All these factors will affect transmission.

Table 4.2-2 JTIDS Class 3 Vehicular Terminal Characteristics (MIFASS)

CHARACTERISTICS	
Voice	Usage about 30%
Data	Usage about 70%
Range (Link Distances):	
Usual	12 - 18 km
Maximum	55 kms
Threat	At least 6 km from FEBA; not under direct enemy observation.
Estimated Input Requirements: (Bn FASC)	
24 hour volume	3478 Messages (100 - 300 bits)
Peak hour volume	35 Messages
Estimated Output Requirements: (Bn FASC)	
24 hour volume	3444 Messages (100 - 300 bits)
Peak hour volume	34 Messages
Required Access Time	1 Second

Table 4.2-2 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (MIFASS)

CHARACTERISTICS (cont)

Operational Restrictions:

Site Selection.............................. Site selection not critical; can have higher antenna than manpack

Weight...................................... Not critical; vehicle mounted; uses vehicle prime power.

Endurance................................... No requirement because operates on vehicle power.

Interoperability Requirements..................... All Class 3 terminals
Class 1 & 2 for coordinating CAS

Display Requirements.............................. JTIDS Display not required. Assumed MIFASS display capability adequate except where DMD is used.

Position Location---------------------------------- Accuracy greater than 30 meters.

Navigation--- Not required.

Table 4.2-2 (cont'd)

NOTES:

1. Usual Distance - represents a range of normal operating distances based on a weighted average for all vehicular terminal participants.
2. Maximum Distance - represents the most extreme distance that can be expected between a set of participants.
3. Required Access Time - see note 3 to Table 4.2-1.

4.3 AIR DEFENSE

This paragraph presents the terminal characteristics for the manpack and vehicular versions of the Class 3 terminal considered for deployment in an air defense network. Typical deployment was used in arriving at some of the data.

The typical deployment is based on a Corps (consisting of 4 Divisions of 3 Brigades each; each Brigade having 5 Maneuver Battalions) operating in a defensive position covering a frontage of approximately 192 Km and a depth of 150 Km. This network includes both the SHORAD facilities and LORAD facilities of the Corps and the Divisions. Tables 4.3-1 and 4.3-2, respectively, present the characteristics for the manpack and vehicular versions of the Class III terminal.

Table 4.3-1 JTIDS Class 3 Manpack Terminal Characteristics (Air Defense)

CHARACTERISTICS	
Voice	Voice primary; no data system at present time
Data	None at this time
Range (Link Distances):	
Usual	5 - 8 km
Maximum	30 km
Threat	Critical; relative close proximity to the FEBA; Direct observation by the enemy; ACS RedEye Team located well forward of FEBA.
Estimated Input Requirements: (RE TM)	
24 hour volume	200 Messages (15 - 20 seconds each)
Peak hour volume	20 Messages
Estimated Output Requirements: (RE TM)	
24 hour volume	120 Messages (15 - 20 seconds each)
Peak hour volume	12 Messages
Required Access Time	30 Seconds

Table 4.3-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (Air Defense)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Antenna placement to preclude observation by the enemy; antenna height restricted.
Weight	Portable by one man (including power pack)
Endurance	Capability to operate away from vehicle for 1 - 2 hours. Airborne operations without vehicle 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals
Display Requirements	JTIDS display required since there is no associated data system.
Position Location	Accuracy greater than 30 meters
Navigation	Not Required

Table 4.3-1 (cont'd)

NOTES:

1. Range - see note 3 to Table 4.1-1.
2. Usual Distance - represents a range of normal operating distances based on a weighted average for all manpack terminal participants.
3. Maximum Distance - represents the most extreme distance that can be expected between a set of participants.
4. Required Access Time - see note 6 to Table 4.1-1.

Table 4.3-2 JTIDS Class 3 Vehicular Terminal Characteristics (Air Defense)

CHARACTERISTICS	
Voice	Voice Primary for SHORAD. Voice less than 10% for LORAD.
Data	None for SHORAD at present time. Greater than 90% for LORAD.
Range (Link Distances):	
Usual	12 - 18 km
Maximum	60 km
Threat	At least 6 km from FEBA; not under direct enemy observation.
Estimated Input Requirements: (IH Bn)	
24 hour volume	3+ million messages (76 - 98 bits)
Peak hour volume	120+ thousand messages
Estimated Output Requirements: (IH Bn)	
24 hour volume	3+ million messages (76 - 98 bits)
Peak hour volume	120+ thousand messages
Required Access Time	less than 1 second

Table 4.3-2 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (Air Defense)

CHARACTERISTICS (cont)

Operational Restrictions:	
Site Selection	Site selection not critical; can have higher antenna than manpack
Weight	Not critical; vehicle mounted; uses vehicle power
Endurance	No requirement because operates on vehicle power
Interoperability Requirements	All Class 3 terminals Class 1 & 2 in LORAD environment Class 1 & 2 in SHORAD if required to operate in Forward Airspace Management Network.
Display Requirements	Display required for SHORAD because no data system. Display not required for LORAD; can use AN/TSQ-73 display capability.
Position Location	Accuracy greater than 30 meters
Navigation	Not Required

Table 4.3-2 (cont'd)

NOTES:

1. Voice - voice is the primary means for SHORAD because there are no data systems at this time. But for LORAD, the AN/TSQ-73 system is used with voice estimated at less than 10%.
2. Data - data primary for LORAD but none for SHORAD at this time because there are no data systems.
3. Range - see note 3 to Table 4.1-1.
4. Usual Distance - represents a range of normal operating distances based on a weighted average for all vehicular terminal participants.
5. Maximum Distance - see note 3 to Table 4.3-1.
6. Required Access Time - see note 6 to Table 4.1-1.

4.4 CLOSE AIR SUPPORT

This paragraph presents the terminal characteristics for the manpack and vehicular versions of the Class 3 terminal considered for use in a close air support network. This network would include CAS for Air Force tactical aircraft as well as CAS for Army attack aircraft. Typical deployment was used in arriving at some of the data. The typical deployment is based on a Corps (consisting of 4 Divisions of 3 Brigades each; each Brigade having 5 Maneuver Battalions) operating in a defensive position covering a frontage of approximately 192 Km and a depth of 150 Km. Tables 4.4-1 and 4.4-2, respectively, present the characteristics for the manpack and vehicular versions of the Class 3 terminal.

Table 4.4-1 JTIDS Class 3 Manpack Terminal Characteristics (CAS/Air Request Net)

CHARACTERISTICS

Voice.. Voice primary; no data systems at present time.

Data.. None at this time

Range (Link Distances):

Usual.................................... 4-6 km

Maximum.................................... 8 km

Threat.. Critical; relative close proximity to the FEBA; Direct observation by the enemy.

Estimated Input Requirements: (FAC)

24 hour volume.............................. 200 Messages (20 -30 seconds each)

Peak hour volume .... 30 Messages

Estimated Output Requirements: (FAC)

24 hour volume.............................. 200 Messages (20 - 30 seconds each)

Peak hour volume............................ 30 Messages

Required Access Time........................ 1 Second

Table 4.4-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (CAS/Air Request Net)

CHARACTERISTICS (cont)

Operational Restrictions:	
Site Selection	Antenna placement to preclude observation by the enemy; antenna height restricted.
Weight	Portable by one man (including power pack)
Endurance	Capability to operate away from vehicle for 3 - 4 hours. Airborne operations without vehicle 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals. Class 1 & 2 for coordinating with CAS aircraft.
Display Requirements	JTIDS display required. No data system associated with user.
Position Location	Accuracy 30 meters or less.
Navigation	Required

Table 4.4-1 (cont'd)

NOTES:

1. Voice - there are no data systems at the present time that can be used for the transmission of CAS data. Voice is the primary means. Future development of AF data systems may lead to automation of this transfer.
2. Range - see note 3 to Table 4.1-1.
3. Usual Distance - see note 2 to Table 4.3-1.
4. Maximum Distance - see note 3 to Table 4.3-1.
5. Required Access Time - see note 6 to Table 4.1-1.

Table 4.4-2 JTIDS Class 3 Vehicular Terminal Characteristics (CAS/Air Request Net)

CHARACTERISTICS	
Voice	Voice primary; no data systems at present time
Data	None at this time; however AF data system may lead to automation of this link in the future.
Range (Link Distances):	
Usual	12 - 18 km
Maximum	85 km
Threat	At least 6 km from FEBA; not under direct enemy observation.
Estimated Input Requirements: (Bn TACP)	
24 hour volume	440 Messages (20 - 30 Seconds each)
Peak hour volume	44 Messages
Estimated Output Requirements: (Bn TACP)	
24 hour volume	440 Messages (20 - 30 seconds each)
Peak hour volume	44 Messages
Required Access Time	30 Second

Table 4.4-2 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (CAS/Air Request Net)

CHARACTERISTICS (cont)

Operational Restrictions:	
Site Selection	Site selection not critical; can have higher antenna than manpack
Weight	Not critical; vehicle mounted; uses vehicle power.
Endurance	No requirement because operates on vehicle power.
Interoperability Requirements	All Class 3 terminals; Class 1 & 2 for coordinating with CAS aircraft.
Display Requirements	JTIDS display required; no data system associated with user.
Position Location	Accuracy greater than 30 meters
Navigation	Required

Table 4.4-2 (cont'd)

NOTES:

1. Voice - see note 1 to Table 4.4-1.
2. Range - see note 3 to Table 4.1-1.
3. Usual Distance - see note 2 to Table 4.3-2.
4. Maximum Distance - see note 3 to Table 4.3-1.
5. Required Access Time - see note 6 to Table 4.1-1.

4.5 FORWARD AIRSPACE MANAGEMENT

This paragraph presents the terminal characteristics for the manpack and vehicular versions of the Class 3 terminals considered for use in a forward airspace management network. A network such as this would involve a wide range of participants in the battlefield including TACFIRE elements, TOS elements, air defense units, Air Force units, and Army air units. Typical deployment was used in arriving at some of the data. The typical deployment is based on a Corps (consisting of 4 Divisions of 3 Brigades each; each Brigade having 5 Maneuver Battalions) operating in a defensive position coverning a frontage of approximately 192 Km and a depth of 150 Km. Tables 4.5-1 and 4.5-2, respectively, present the characteristics for the manpack and vehicular versions of the Class 3 terminal.

Table 4.5-1. JTIDS Class 3 Manpack Terminal Characteristics (Forward Airspace Management)

CHARACTERISTICS	
Voice	Primary voice at present time; TACFIRE and AN/TSQ-73 participants can transmit and receive data. Future development may lead to data system similar to ATMAC.
Data	Data capability only exists for TACFIRE and AN/TSQ-73 participants.
Range (Link Distances):	
Usual	5 - 8 Km
Maximum	15 - 20 Km
Threat:	Critical; close proximity to the enemy; direct enemy observation; subject to loss and/or compromise.
Estimated Input Requirements:	
24 hour volume	100 messages (20 - 30 seconds each)
Peak hour volume	10 messages
Estimated Output Requirements:	
24 hour volume	100 messages (20 - 30 seconds each)
Peak hour volume	10 messages
Required Access Time	1 second

Table 4.5-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (Forward Airspace Management)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Critical placement; antenna height restricted
Weight	Portable by one man (including power pack)
Endurance	Capability to operate away from vehicle for 3-4 hours. Airborne operations without vehicle 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals. Class 1 & 2 for coordinating with aircraft.
Display Requirements	JTIDS display required for users not associated with other data system such as TACFIRE, AN/TSQ-73, etc.
Position Location	Accuracy 30 meters or less.
Navigation	Required.

Table 4.5-1 (cont'd)

NOTES:

1. Voice - at the present time not all participants have data systems that can be used for the transfer of airspace management data. Only TACFIRE and AN/TSQ-73 participants have data capability. Therefore, voice is the primary means at this time.
2. Data - data capability only exists for TACFIRE and AN/TSQ-73 participants at the present time but it is expected that future development in Army and AF data systems will produce a data system similar to ATMAC for forward airspace management.
3. Range - see note 3 to Table 4.1-1.
4. Usual Distance - see note 2 to Table 4.3-1.
5. Maximum Distance - see note 3 to Table 4.3-1.
6. Required Access Time - see note 6 to Table 4.1-1.

Table 4.5-2 JTIDS Class 3 Vehicular Terminal Characteristics (Forward Airspace Management)

CHARACTERISTICS	
Voice	Primarily voice at present time; TACFIRE and AN/TSQ-73 participants can transmit and receive data; future development may lead to data system similar to ATMAC.
Data	Data capability only exists for TACFIRE and AN/TSQ-73 participants.
Range (Link Distances):	
Usual	12 - 18 Km
Maximum	60 Km
Threat	At least 6 Km from FEBA, not under direct enemy observation.
Estimated Input Requirements:	
24 hour volume	300 messages (20-30 seconds each)
Peak hour volume	30 messages
Estimated Output Requirements:	
24 hour volume	300 messages (20 - 30 seconds each)
Peak hour volume	30 messages
Required Access Time	30 seconds

Table 4.5-2 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (Forward Airspace Management)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Site selection not critical; can have higher antenna than manpack.
Weight	Not critical; vehicle mounted; uses vehicle power.
Endurance	No requirement because operates on vehicle power.
Interoperability Requirements	All Class 3 terminals; Class 1 & 2 for coordinating with aircraft.
Display Requirements	JTIDS display required for users not associated with other data system such as TACFIRE, AN/TSQ-73, etc.
Position Location	Accuracy greater than 30 meters.
Navigation	Required.

Table 4.5-2 (cont'd)

NOTES:

1. Voice - see note 1 to Table 4.5-1.
2. Data - see note 2 to Table 4.5-1.
3. Range - see note 3 to Table 4.1-1.
4. Usual Distance - see note 2 to Table 4.3-1.
5. Maximum Distance - see note 3 to Table 4.3-1.
6. Required Access Time - see note 6 to Table 4.1-1.

4.6 BATTLEFIELD INTELLIGENCE COLLECTION AND DISSEMINATION

This paragraph presents the terminal characteristics for the manpack, vehicular, and helicopter versions of the Class 3 terminal considered for use in a battlefield intelligence collection and dissemination network. Here again we are dealing with a network composed of participants covering a wide range of activities over the battle area such as TOS users, air reconnaissance participants, as well as air and ground sensor systems and other data systems that provide and disseminate intelligence data. Typical deployment was used in arriving at some of the data. The typical deployment is based on a Corps (consisting of 4 Divisions of 3 Brigades each; each Brigade having 5 Maneuver Battalions) operating in a defensive position covering a frontage of approximately 192 Km and a depth of 150 Km. Tables 4.6-1, 4.6-2, and 4.6-3, respectively, present the characteristics for the manpack, vehicular, and helicopter versions of the Class 3 terminal.

Table 4.6-1 JTIDS Class 3 Manpack Terminal Characteristics

(Battlefield Intelligence Collection and Dissemination)

CHARACTERISTICS	
Voice	Usage less than 5%. Most participants possess the capability to transmit and receive digitally.
Data	Primary usage more than 95%.
Range (Link Distances):	
Usual	5 - 10 Km
Maximum	15 Km
Threat	Critical; close proximity to the enemy; direct enemy observation; subject to loss and/or compromise.
Estimated Input Requirements:	
24 hour volume	100 messages (TOS format with 1024 characters)
Peak hour volume	10 messages
Estimated Output Requirements:	
24 hour volume	50 messages (TOS format with 1024 characters)
Peak hour volume	5 messages
Required Access Time	> 15 seconds

Table 4.6-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (Battlefield Intelligence Collection and Dissemination)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Critical placement; antenna height restricted.
Weight	Portable by one man (including power pack).
Endurance	Extended operation away from vehicle of 3 - 4 hours; airborne operations without vehicle 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals. Class 1 & 2 terminals for coordination with aircraft.
Display Requirements	Display required only for those participants who are not directly associated with a tactical data system.
Position Location	Accuracy of 30 meters or less
Navigation	Required.

Table 4.6-1 (cont'd)

NOTES:

1. Range - see note 3 to Table 4.1-1.
2. Usual Distance - see note 2 to Table 4.3-1.
3. Maximum Distance - see note 3 to Table 4.3-1.
4. Required Access Time - see note 6 to Table 4.1-1.

Table 4.6-2 JTIDS Class 3 Vehicular Terminal Characteristics

(Batttlefield Intelligence Collection and Dissemination)

CHARACTERISTICS	
Voice	Usage less than 5%. Most participants possess the capability to transmit and receive digitally.
Data	Primary usage more than 95%.
Range (Link Distances):	
Usual	12 - 18 Km
Maximum	85 Km
Threat	At least 6 Km from FEBA; not under direct enemy observation.
Estimated Input Requirements:	
24 hour volume	400 - 500 messages (TOS format with 1024 characters)
Peak hour volume	40 - 50 messages
Estimated Output Requirements:	
24 hour volume	400 - 500 messages (TOS format with 1024 characters)
Peak hour volume	40 50 messages
Required Access Time	> 15 seconds

Table 4.6-2 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (Battlefield Intelligence Collection and Dissemination)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Site selection not critical; can have higher antenna than manpack.
Weight	Not critical; vehicle mounted; uses vehicle power.
Endurance	No requirement because operates on vehicle power.
Interoperability Requirements	All Class 3 terminals; Class 1 and 2 for coordinating with aircraft.
Display Requirements	Display required only for those participants who are not directly associated with a tactical data system.
Position Location	Accuracy greater than 30 meters.
Navigation	Required.

Table 4.6-2 (cont'd)

NOTES:

1. Range - see note 3 to Table 4.1-1.
2. Usual Distance - see note 2 to Table 4.3-1.
3. Maximum Distance - see note 3 to Table 4.3-1.
4. Required Access Time - see note 6 to Table 4.1-1.

Table 4.6-3 JTIDS Class 3 Helicopter Terminal Characteristics

(Battlefield Intelligence Collection and Dissemination)

CHARACTERISTICS	
Voice	Usage less than 5%.
Data	Primary usage more than 95%.
Range (Link Distances):	
Usual	44 Km
Maximum	50 Km
Threat	Critical; close proximity to enemy; direct enemy observation.
Estimated Input Requirements:	
24 hour volume	100 messages (short; probably fixed format).
Peak hour volume	10 messages
Estimated Output Requirements:	
24 hour volume	100 messages (short; probably fixed format)
Peak hour volume	10 messages
Required Access Time	> 15 seconds

Table 4.6-3 (cont'd)

JTIDS Class 3 Helicopter Terminal Characteristics (Battlefield Intelligence Collection and Dissemination).

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Antenna height makes no difference; no site selection; on the move; direct enemy observation.
Weight	May be limited by helicopter mounting; otherwise not critical.
Endurance	No requirement; operates on aircraft power.
Interoperability Requirements	All Class 3 terminals. Class 1 and 2 for intercommunication with other aircraft.
Display Requirements	Onboard display is desirable to provide position location and navigational aid; display of short command type messages.
Position Location	Accuracy of 30 meters or less.
Navigation	Required.

Table 4.6-3 (cont'd)

NOTES:

1. Range - see note 3 to Table 4.1-1.
2. Usual Distance - see note 2 to Table 4.3-1.
3. Maximum Distance - see note 3 to Table 4.3-1.
4. Volume - is estimated and assumed to be relatively short messages capable of easy preparation and display and probably in some sort of coded fixed format similar to DMD format.
5. Required Access Time - see note 6 to Table 4.1-1.

4.7 TOS

This paragraph presents the terminal characteristics for the vehicular version of the Class 3 terminal considered for use in a TOS network. Typical deployment was used in deriving some of the data. The typical deployment is based on a Corps (consisting of 4 Divisions of 3 Brigades each; each Brigade having 5 Maneuver Battalions) operating in a defensive position covering a frontage of approximately 192 Km and a depth of 150 Km. Tables 4.7-1 presents the characteristics for the vehicular version of the Class 3 terminal. No manpack version is considered here since current configuration of TOS does not provide TOS terminal equipment below the level of the battalion.

Table 4.7-1 JTIDS Class 3 Vehicular Terminal Characteristics (TOS)

CHARACTERISTICS	
Voice	Usage less than 5%.
Data	Primary usage more than 95%.
Range (Link Distances):	
Usual	12 - 18 Km
Maximum	100 Km
Threat	At least 6 Km from FEBA; not under direct enemy observation.
Estimated Input Requirements:	
24 hour volume	400 - 500 messages (TOS format of 1024 characters)
Peak hour volume	40 - 50 messages
Estimated Output Requirements:	
24 hour volume	400 - 500 messages (TOS format of 1024 characters)
Peak hour volume	40 - 50 messages.
Required Access Time	30 seconds.

Table 4.7-1 (cont'd)

JTIDS Class 3 Vehicular Terminal Characteristics (TOS)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Site selection not critical; can have higher antenna than manpack.
Weight	Not critical; vehicle mounted; uses vehicle power
Endurance	No requirement because operates on vehicle power.
Interoperability Requirements	All Class 3 terminals.
Display Requirements	Display provided by TOS adequate to handle all requirements. No Class 3 terminal display desired.
Position Location	Accuracy of greater than 30 meters.
Navigation	Not required.

Table 4.7-1 (cont'd)

NOTES:

1. Voice - a TOS user can complete all mission requirements by use of digital transmission means. Therefore, voice only needed as backup and for command and control.
2. Data - transmission will be in the form of variable format messages with a maximum length of 1024 characters. TOS will operate at a serial bit rate of 600 or 1200 bps. Evolution of TOS may produce a more efficient coding system thereby reducing message size.
3. Range - see note 3 to Table 4.1-1.
4. Usual Distance - see note 2 to Table 4.3-1.
5. Maximum Distance - see note 3 to Table 4.3-1.
6. Required Access Time - see note 6 to Table 4.1-1.

4.8 REMOTE PILOTED VEHICLE (RPV)

This paragraph presents the terminal characteristics for the missile/RPV version of the Class 3 terminal. Because of the classified nature of operating distances, they are not included here but can be obtained from paragraph 3.3.8 of the Supplement to Appendix I. RPV ranges were discussed because this was the only type of information provided by government documentation. However, RPV ranges do provide a close approximation to link distances. The physical distances between other participants were not determinable from the information provided. Input and output requirements are unknown at this time. Table 4.8-1 presents the known characteristics for the missile/RPV version of the Class 3 terminal.

Table 4.8-1 JTIDS Class 3 Missile/RPV Terminal Characteristics (Remote Piloted Vehicle)

CHARACTERISTICS	
Voice	There will be no voice communications.
Data	All data transmission
Range (Link Distances):	
Usual	(Classified)
Maximum	(Classified)
Threat	Will operate in close proximity to the enemy; direct enemy observation
Estimated Input Requirements:	
24 hour volume	Unknown (probably 75 - 125 bits in length)
Peak hour volume	Unknown
Estimated Output Requirements:	
24 hour volume	Unknown
Peak hour volume	Unknown
Required Access Time	Unknown

Table 4.8-1 (cont'd)

JTIDS Class 3 Missile/RPV Terminal Characteristics (Remote Piloted Vehicle)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection.................................	Antenna height makes no difference; no site selection; on the move; direct enemy observation.
Weight..................................	May be limited by RPV mounting; otherwise not critical.
Endurance..................................	Must be capable of operation for extended period on RPV supplied power.
Interoperability Requirements......................	All Class 1, 2, and 3 terminals.
Display Requirements............................	Not required on the unmanned RPV.
Position Location------------------------------	Greater than 30 meters.
Navigation------------------------------------	Required.

4.9 LANDING CRAFT CONTROL

This paragraph presents the terminal characteristics for the shipboard version of the Class 3 terminal considered for use in a landing craft control network. A concept of employment of an amphibious force was used to determine some of the data. Table 4.9-1 presents the characteristics of the shipboard version of the Class 3 terminal.

Table 4.9-1 JTIDS Class 3 Shipboard Terminal Characteristics (Landing Craft Control)

CHARACTERISTICS	
Voice	No voice transmission anticipated.
Data	All digital transmission
Range (Link Distances):	
Usual	8 - 12 Km
Maximum	15 Km
Threat	Critical; close proximity to the enemy at shore point; direct enemy observation
Estimated Input Requirements:	
Hour volume	360 messages (short; concise messages)
Estimated Output Requirements:	
Hour volume	360 messages (short; concise messages)
Required Access Time	5 seconds

Table 4.9-1 (cont'd)

JTIDS Class 3 Shipboard Terminal Characteristics (Landing Craft Control)

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Site selection unimportant; time element precludes need for concealment.
Weight	Not critical; shipboard mounted.
Endurance	No requirement; operate off shipboard power.
Interoperability Requirements	All Class 3 terminals. Class 1 & 2 terminals that may be operating on control and launch platforms.
Display Requirements	Display required to depict relative positioning and control measures.
Position Location	Accuracy greater than 30 meters.
Navigation	Required.

4.10 FORWARD TERMINAL OPERATIONS

This paragraph presents the terminal characteristics for the manpack version of the Class 3 terminal considered for use in a "bare base" operation. Since the CCT and supporting forces are the first into the objective area, the manpack terminal is the version to be used. Table 4.10-1 presents the characteristics of the manpack version of the Class 3 terminal.

Table 4.10-1 JTIDS Class 3 Manpack Terminal Characteristics (Forward Terminal Operations)

CHARACTERISTICS	
Voice	Expected to be less than 10%.
Data	Primary usage expected to be greater than 90%.
Range (Link Distances):	
Usual	12 - 16 Km
Maximum	36 Km
Threat	Operating in enemy held territory; subject to direct enemy observation; subject to compromise and/or loss.
Estimated Input Requirements:	
Hour volume	180 messages
Estimated Output Requirements:	
Hour volume	180 messages
Required Access Time	10 seconds

Table 4.10-1 (cont'd)

JTIDS Class 3 Terminal Characteristics

CHARACTERISTICS (cont)	
Operational Restrictions:	
Site Selection	Site selection critical; in close proximity to enemy; direct enemy observation.
Weight	Portable by one man (including power pack)
Endurance	Extended airborne operations without vehicle for 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals. Class 1 and 2 for coordination with aircraft.
Display Requirements	JTIDS graphic display desirable to assist in relative positioning and display of commands.
Position Location	Accuracy probably less than 30 meters.
Navigation	Required.

4.11 BEACHHEAD/AIRHEAD OPERATIONS.

This paragraph presents the terminal characteristics for the manpack version of the Class 3 terminal considered for use in a beachhead/airhead operations network. In each instance we are dealing with an operation that may be in close proximity to the enemy and is a relatively compacted area of operation. Table 4.11-1 presents the characteristics of the manpack version of the Class 3 terminal.

Table 4.11-1 JTIDS Class 3 Manpack Terminal Characteristics (Beachhead/Airhead Operations)

CHARACTERISTICS	
Voice	Expected to be less than 5%. Backup probably provided by other logistical radio network.
Data	Primary usage expected to be greater than 95%.
Range (Link Distances):	
Usual	12 - 16 Km
Maximum	36 Km
Threat	Operating in enemy held territory or in close proximity to enemy; direct enemy observation.
Estimated Input Requirements:	
Hour volume	200 messages
Estimated Output Requirements:	
Hour volume	200 messages
Required Access Time	15 seconds

Table 4.11-1 (cont'd)

JTIDS Class 3 Manpack Terminal Characteristics (Beachhead/Airhead Operations)

CHARACTERISTICS (cont)

Operational Restrictions:

Site Selection	Site selection critical; close proximity to enemy; direct enemy observation.
Weight	Portable by one man (including power pack)
Endurance	Must be capable of operating away from vehicle for extended periods of 24 - 48 hours.
Interoperability Requirements	All Class 3 terminals. Class 1 and 2 for intercommunication with airborne and shipborne platforms.
Display Requirements	JTIDS terminal display desirable to provide visual presentation of data.
Position Location	Accuracy greater than 30 meters.
Navigation	Required.

LIST OF ABBREVIATIONS

AALC	Amphibious Assult Landing Craft
A/C	Aircraft
ACE	Airspace Coordination Element
ACR	Armored Cavalry Regiment
ACS	Armored Cavalry Squadron
ADA	Air Defense Artillery
ADO	Air Defense Officer
AE	Aerial Exploitation
AF	Air Force
AFAC	Air Forward Air Controller
ALP	Air Liaison Party
AO	Aerial Observer
AO_x	Oiler
ASRT	Air Support Radar Team
ASW	Antisubmarine Warfare
ATF	Assault Task Force
AWACS	Airborne Warning and Control System
BACE	Brigade Airspace Coordination Element
BCC	Battle Coordination Center
BCE	Battle Coordination Element
BDE	Brigade
BDU	Battery Display Unit
BN	Battalion
BTE	Battery Terminal Equipment, AN/GSA-77, Data Converter

LIST OF ABBREVIATIONS (Cont'd)

BTRY	Artillery Battery
CATF	Commander, Amphibious Task Force
CCC	Corps Computer Center (TOS)
CCG	Command and Control Group
CEWI	Combat Electronic Warfare Intelligence
CG	Cruiser, Guided Missile
CGN	Cruiser, Guided Missile, Nuclear
CLF	Commander, Landing Force
CO	Company
COMDR	Commander
COSCOM	Corps Support Command
CP	Command Post
CRC	Control and Reporting Center
CTOC	Corps Tactical Operations Center
CV	Aircraft Carrier
DAME	Division Airspace Management Element
DASC	Direct Air Support Center
DCC	Division Computer Center (TOS)
DD	Destroyer
DDG	Destroyer, Guided Missile
DE	Escort Ship
DISCOM	Division Support Command
DIV	Division
DIV ARTY	Division Artillery

LIST OF ABBREVIATIONS (Cont'd)

DMD	Digital Message Device
DS	Artillery Direct Support
DTOC	Division Tactical Operations Center
ECS	Engagement Control Station
EWIOC	Electronic Warfare Intelligence Operations Center
FAAR	Forward Area Alert Radar
FACP	Forward Air Control Party
FAMAS	Field Artillery Meteorological Acquisition System
FASC	Fire and Air Support Center
FASS	Fire and Air Support Section
FDC	Fire Direction Center
FFG	Frigate, Guided Missile
FO	Forward Observer
FSCC	Fire Support Coordination Center
FSE	Fire Support Element
FSO	Fire Support Officer
FU	Fire Unit
GCS	Ground Control Station
GFAC	Ground Forward Air Controller
GM	Guided Missile
GS	Artillery General Support
HAWK	Homing All the Way Killer
HCPTR	Helicopter
HIMAD	High-to-Medium Altitude Air Defense

LIST OF ABBREVIATIONS (Cont'd)

IH	Improved Hawk
INTEL	Intelligence
LCC	Amphibious Command Ship
LG	Launching Group
LHA	Landing Craft Helicopter Assault
LKA	Landing Craft Transport Assault
LOMAD	Low-to-Medium Altitude Air Defense
LORAD	Long Range Air Defense
LPD	Amphibious Transport Dock
LPH	Amphibious Assault Ship
LSD	Landing Ship Dock
LST	Landing Ship Tank
MAB	Marine Amphibious Brigade
MAF	Marine Amphibious Force
MAG	Marine Aircraft Group
MAGIIC	Mobile Army Ground Imagery Interpretation Center
MIFASS	Marine Integrated Fire and Air Support System
MS	Master Station
MSH	Mine Sweeper, Helicopter
MTD	Mounted
NGF	Naval Gunfire
NGLP	Naval Gunfire Liaison Party
NGST	Naval Gunfire Spot Team

LIST OF ABBREVIATIONS (Cont'd)

OPS	Operations
PLT	Platoon
Q-73	AN/TSQ-73 Missile Minder System
RE	Redeye
REGT	Regiment
REMBASS	Remotely Monitored Battlefield Sensor System
RPV	Remotely Piloted Vehicle
RS	Radar Station
SACC	Supporting Comm Coordination Center (Navy)
SBCC	Separate Brigade Computer Center
SF	Special Forces
SFCP	Shore Fire Control Party
SHORAD	Short Range Air Defense
SOTAS	Stand-Off Target Acquisition System
SP	Self Propelled
SSN	Submarine, Nuclear Powered
TACC	Tactical Air Command Center
TAC CP	Tactical Command Post
TACFIRE	Tactical Fire Direction System
TACP	Tactical Air Control Party
TAOC	Tactical Air Operations Center
TASE	Tactical Air Support Element
TCAC	Technical Control and Analysis Center

LIST OF ABBREVIATIONS (Cont'd)

TCAS	Technical Control and Analysis System
TCS	Tactical Computer System (TOS)
TCT	Tactical Computer Terminal (TOS)
TDS	Tactical Display System (TOS)
TFCC	Tactical Fire Coordination Center
TGT ACQ	Target Acquisition
TM	Team
TOS	Tactical Operations System
TRK	Truck
TSC	Tactical Support Center
TSQ-91	AN/TSQ-91 U.S. Air Force Tactical Air Control System Combat Reporting Center/Post
TUOC	Tactical Unit Operations Center
UDT	Underwater Demolition Team
VFMED	Variable Format Message Entry Device
WS	Weather Station
WWMCCS	World Wide Military Command and Control System

JOINT TACTICAL INFORMATION

DISTRIBUTION SYSTEM

(JTIDS)

CLASS 3 TERMINAL CONCEPTUAL STUDY

APPENDIX B

MOMENTS OF THE DECISION VARIABLE

FOR PREAMBLE DETECTION

7 JULY 1978

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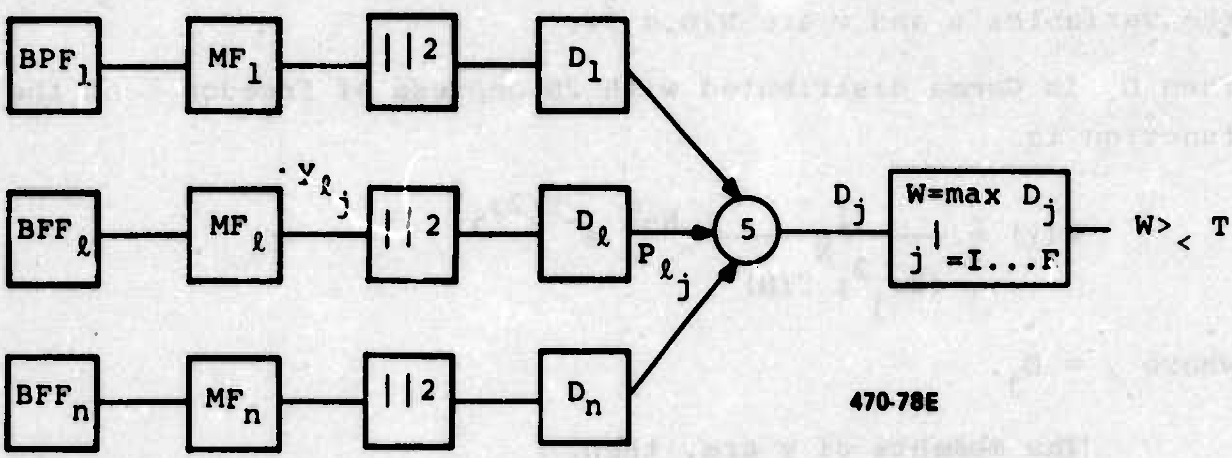
The record

In this Appendix the moments of the decision variable used for preamble detection are determined.

The model for the preamble detection circuit is shown in the Figure below.



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Here the variables y_{ℓ_j} and D_j are shown. D_j is called the decision variable. In this Appendix the moments of D_j will be derived.

The variable D_j, at time sample j, can be written as

$$D_j = \sum_{\ell=1}^{N} |y_{\ell_j}|^2$$

There are three distinct cases:

1. y consists of only noise
2. y consists of signal produced noise and white Gaussian noise
3. y consists of signal and noise

I. <u>Noise Only Case</u>

Let the noise samples be written as n_i. Then

$$y_{\ell j} = \sum_{s=1}^{L} b^*_{s\ell} \; n_{j-s} = u + iv$$

where $b_{s\ell}$ is the PN code value for the ℓ^{th} branch, $s = 1,\ldots L$ and the variables u and v are $N(0,\sigma_j^2)$.

Then D_j is Gamma distributed with 2N depress of freedom, and the density function is

$$P(\chi) = \frac{1}{(2\sigma_j^2)^N \, \Gamma(N)} \chi^{N-1} e^{-\chi/2\sigma_j^2}$$

where $\chi = D_j$.

The moments of y are, then,

$E(y_{\ell j}) = 0$

$$E \; |y_{\ell j}|^2 = \sum_{s=1}^{L} \sum_{t=1}^{L} \overline{b^*_s \; b_t} \; \overline{n_{j-s} \; n^*_{j-t}}$$

$$= \sum_{s=1}^{L} 2\,\sigma_n^2 = 2L\sigma_n^2$$

where $\overline{n_j \; n_t} = 2\sigma_n^2 \; \delta_{jt}$

$|b_{s\ell}|^2 = \delta_{s\ell}$

It follows that

$$E\left\{D_j\right\} = 2LN\sigma_n^{\ 2}$$

Since D_j is Gamma distributed, we know that

$$V\left\{D_j\right\} = 2 \times 2N\ (L\sigma_n^{\ 2})^2 = 4NL^2\sigma_n^{\ 4}$$

Let us define a central χ^2 random variable g_c with 2N d.f. by

$$g_c = \frac{D_j}{L\sigma_n^{\ 2}}$$

II. Noise and signal-dependent correlation noise.

In this case,

$$y_{\ell j} = \sum_{s=1}^{L} b^*_{s\ell}\ (a_{j-s,\ell} + n_{j-s})$$

$$= \sum_{s=1}^{L-|\alpha|} b^*_{s\ell}\ a_{j-s,\ell} + \sum_{s=1}^{L} b^*_{s\ell}\ n_{j-s}$$

where α = number of chips off sync in a pulse, $0 \leq |\alpha| \geq L$

then

$$E\left\{y_{\ell j}\right\} = 0$$

and

$$E\left\{|y_{\ell j}|^2\right\} = \sum_s \sum_t \overline{b^*_{s\ell}\, b_{t\ell}(a_{j-s,\ell} + n_{j-s})\,(a^*_{j-t,\ell} + n^*_{j-t})}$$

$$= \sum_{s=1}^{L-|\alpha|} \sum_{t=1}^{L-|\alpha|} \overline{b^*_{s\ell}\, b_{t\ell}\, a_{j-s,\ell}\, a^*_{j-t,\ell}} + \sum_{s=1}^{L} \sum_{t=1}^{L} \overline{b^*_{s\ell}\, b_{t\ell}\, n_{j-s}\, n^*_{j-t}}$$

Using the following equality for Gaussian random variables with zero mean

$$\overline{\zeta_1 \zeta_2^* \zeta_3 \zeta_4^*} = \overline{\zeta_1 \zeta_2^*}\;\overline{\zeta_3 \zeta_4^*} + \overline{\zeta_1 \zeta_4^*}\;\overline{\zeta_2^* \zeta_3}$$

we have

$$\overline{b^*_{s\ell}\, b_{t\ell}\, a_{j-s,\ell}\, a^*_{j-t,\ell}} = \overline{b^*_{s\ell}\, b_{t\ell}}\;\overline{a_{j-s,\ell}\, a^*_{j-t,\ell}}$$

$$+ \overline{b^*_{s\ell}\, a^*_{j-t,\ell}}\;\overline{b_{t\ell}\, a_{j-s,\ell}} = \delta_{st}$$

Thus,

$$E\left\{|y_{\ell j}|^2\right\} = \sum_{s=1}^{L-|\alpha|} \sum_{t=1}^{L-|\alpha|} \delta_{st} + \sum_{s=1}^{L} \sum_{t=1}^{L} \delta_{st}\, 2\,\sigma_n^2$$

$$= L - |\sigma| + 2L\sigma_n^2$$

$$= V\{Y_{\ell j}\}$$

Then,

$$E\{D_j\} = 2N\left(\frac{L - |\alpha|}{2} + L\sigma_n^2\right)$$

and, since D_j is Gamma distributed,

$$\mathrm{Var}\{D_j\} = 4N\left(\frac{L - |\alpha| + 2L\sigma_n^2}{2}\right)^2$$

$$= N\,(L - |\alpha| + 2L\sigma_n^2)^2$$

The central x^2 r.v.g_c with 2N degrees of freedom may be formed by

$$g_c = \frac{D_j}{\frac{L-\boxed{x}}{2} + L\sigma_n^2}$$

III. Signal and Noise

Now

$$Y_{\ell j} = \sum_{s=1}^{L} a^*_{j\ell}(a_{j-s,\ell} + n_{j-s})$$

To indicate the in-sync position of the output variable we let j=s.

$$Y_{\ell s} = \sum_{s=1}^{L} |a_{s,\ell}|^2 + \sum_{s=1}^{L} a^*_{s\ell}\, n_{-s}$$

$$= L + \sum_{j=1}^{L} a^*_{s\ell}\, n_{-s}$$

Let

$$\xi = \sum_{s=1}^{L} a^*_{je}\, n_{-s}$$

Then

$$E\{Y_{\ell s}\} = L$$

and

$$E\{|Y_{\ell s}|^2\} = L^2 + \sum_{s=1}^{L} \sum_{t=1}^{L} \overline{a_{je}^* n_{-s} a_{te} n_{-t}^*}$$

$$= L^2 + 2L\sigma_n^2$$

Since

$$\overline{a_{je}^* a_{te} n_{-s} n_{-t}^*} = 2\sigma_n^2 \sigma_{st}$$

We have

$$E\{D_s\} = N(L^2 + 2L\sigma_n^2)$$

To find the variance of D_j, we need

$$E\{|Y_{\ell s}|^4\} = \overline{|L+\xi|^4} = L^4 + 4L^2\overline{|\xi|^2} + \overline{|\xi|^4}$$

Also

$$\overline{|\xi|^4} \sum_{s=1}^{L} \sum_{t=1}^{L} \sum_{u=1}^{L} \sum_{v=1}^{L} \overline{a_{j\ell}^* a_{t\ell} a_{u\ell}^* a_{v\ell}} \cdot \overline{n_{-s} n_{-\ell}^* n_{-u} n_{-v}^*}$$

$$\overline{n_{-s} n_{-t}^* n_{-u} n_{-v}^*} = \overline{n_{-s} n_{-t}^* n_{-u} n_{-v}^*} + \overline{n_{-s} n_{-v}^* n_{-t}^* n_{-u}}$$

$$= \sigma_{st}\sigma_{uv}(2\sigma_n^2)^2 + \sigma_{sv}\sigma_{ut}(2\sigma_n^2)^2$$

Then

$$\overline{|\xi|^4} = 2L^2(4\sigma_n^4) = 8L^2\sigma_n^4$$

Also

$$|\xi|^2 = 2L\sigma_n^2$$

and

$$E\{|Y_{\ell s}|^4\} = L^4 + 4L^2(2L\sigma_n^2) + 8L^2\sigma_n^4$$

$$= L^4 + 8L^3\sigma_n^2 + 8L^2\sigma_n^4$$

$$V\{|Y_{\ell s}|^2\} = L^4 + 8L^3\sigma_n^2 + 8L^2\sigma_n^4 - (L^2 + 2L\sigma_n^2)^2$$

$$= 4L^2\sigma_n^2(L+\sigma_n^2)$$

and then

$$V\{D_s\} = N4L^2\sigma_n^{\,2}(L + \sigma_n^{\,2})$$

We form the noncentral X^2 random variable g_{Nc} with 2N degrees of freedom and noncentrality parameter $\lambda = NL/\sigma_n^{\,2}$ by defining

$$g_{Nc} = \frac{D_s}{L\sigma_n^{\,2}}$$

so that

$$E\{g_{Nc}\} = \lambda + 2N = \frac{NL}{\sigma_n^{\,2}} + 2N$$

$$V(g_{Nc}) = 4\lambda + 4N = 4NL/\sigma_n^{\,2} + 4N$$